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## CONTENTS.

An Asterisk (*) denotes an illustrated article.


EDITORIALS—

Briefly Told ..... 849
Odd Manifestations Over Gas Supply in Three Eastern Cities—Obituary Note, the Hon. Robert Sherrard—Notes.

Novelties in the Gas Lighting Field ..... 851
Methods of Heat Insulation ..... 851
The Rating and Behavior of Fuse Wires ..... 852
The Electric Lighting Plant of the Philadelphia Main Station, P. and R. R. Co. ..... 853
*Roberts Improved Water Gas Apparatus ..... 854
*Carbonic Anhydride Refrigerating Machines ..... 856
ITEMS OF INTEREST FROM VARIOUS LOCALITIES ..... 860
Col. C. A. White Goes to Fort Wayne, Ind.—The Western Gas Construction Company Increases Its Capital—To Increase the Capacity of the Athens (Ga.) Plant—Filling Vacancies in the Management of the Newark (N. J.) Company—To Settle the Differences at Racine, Wis.—A Gas Thief Fined—The East Newark (N. J.) Company Reorganized—Suing the Sewer Contractors, Portsmouth, Va.—The Warsaw (N. Y.) Company Reorganized—Death of Mr. Jas. Clements—New Gas Inspector for Cleveland, Ohio—Public Lighting, New York City—Something from Hartford, Conn.—Memorial Resolutions to the Late Mr. J. D. Deshong—The Syracuse (N. Y.) Company Changes Hands—Matters Before the Massachusetts Commissioners—The Chemung Gas and Electric Company—Something from Memphis, Tenn.—And Many Other Items.
The Preparation of Graphite ..... 861
Steam Separators ..... 862
Air Burning in Gas ..... 862
The Market for Gas Securities ..... 862


## BRIEFLY TOLD.

ODD MANIFESTATIONS OVER GAS SUPPLY IN THREE EASTERN CITIES.—The residents of the "effete East" have hitherto had the credit of dealing fairly with those who supplied them with anything they were inclined to use for their sustenance, comfort or pleasure—no matter whether the sellers were incorporated companies or individuals who elected to engage in commerce without the "safety" which is supposed to follow the seal of the State, when that seal is put upon the papers filed with the authorities who dwell officially in capitols—provided that the selling company or individual kept within the letter of its agreement, or his circumstance in the market, so far as the prices of his wares could be determined by the supply of that which he sells was at his command, or so far as the money owned by his customers could enable them to purchase. Perhaps we could have stated the above somewhat lengthy and breath breaking proposition in easier fashion by writing it down that the company which kept its faith with the State, and the individual who regulated his prices from the conditions of supply and demand which prevailed in his district, have heretofore been respected in the East; but whether so or not, the fact remains that those who buy in this section of the country are seemingly fast approaching the belief and practice that ruled the "White Companies" of the days of yore. It is not now with the buyer whether he shall pay for what he needs, nor that he shall respect the promise that he made to the seller, but it is with him how shall he obtain, without any payment, if possible, that which his neighbor has and that he needs, but has not. We have had put before us within the last few weeks three pretty good examples of this sort of thing, perhaps the most striking of which is instanced in the action of the Providence (R. I.) City Council, whose membership are wrestling with a desire, as shown in their adoption of a resolution to do a "whole lot" of investigation respecting price and quality of gas distributed in that city, to overturn the contract now existing, and *to exist* for several years, between the city and the Providence Gas Company. The average Providence Alderman of to-day believes that the Company ought to be forced to sell its product for $1 per 1,000, although his fellows of two or three years ago determined that the schedule of scaling rates then adopted to rule during the contract was more than fair. Providence and the spirit of Roger Williams are supposed to be co equal, but it would be a poor observer of to day who claimed that Providence is not outstripping its spirit. Under the existing agreement between the city of Providence and the local Gas Company the latter paid last year to its "protectors," in taxes (including the 3 per cent. return on its gross sales of gas), a sum amounting to $70,000, which is a larger sum *pro rata* than that paid into the Providence treasury by any other corporation or individual in the named city. If agreements go, and in the Providence case at notice they must for some time to come, we submit that the Providence Gas Company ought to be blessed by the Providential Aldermen of that city, rather than that it should be banned by the "gentlemen" whose rotten political courses can only be yearly stayed by the administering of a dose of blackmail. Of course, it is but a manifestation of rotten politics—backed possibly by the dying beseechment of the Narragansett Electric Light Company—but the fact remains that one of the three odd manifestations over gas supply in the East is in evidence in Rhode Island's handsome chief

city. The second instance of this manifestation is shown in the Charlestown district of Boston, where the Charlestown Improvement Association, early in October, met in solemn conclave and voted that the price of gas there was too high—by way of contrast, we do not seek to have it implied that the Improvement Association is on a parity with the Providence Common Council (for the former is undoubtedly impelled by motives other than blackmailing), but we do go on record as saying that the result sought to be reached by each is identical. The Improvement Association asked that the Charlestown Company (the average price received by it for gas sold during the fiscal year ended June 30, 1894, was $1.46 per 1,000 cubic feet) be obliged to cut its selling rate to $1 per 1,000, the "Hurleyites," or favorers of the motion, asserting that the Charlestown district should have its gas as cheap as that sold in Boston proper—or at the rate of $1 per 1,000. No attention was paid to the disparity in output between Boston proper and the Charlestown district (the difference is that existing between an output of 2½ thousand millions and one of 90 millions), nor was any consideration given to the promise by Treasurer Neal, of the Charlestown Company, that, with January 1st, 1896, the rate would be cut to $1.25. The Improvement Association, "rising superior to the occasion," determined that $1 gas was their aim, so they would try to hit that and nothing else. Wherefore, we have the second odd Eastern manifestation; nor does the second instance in effect differ from the first, save that it is the echo of the prating of fools rather than the shrieking of the unfed political vulture. The third odd manifestation is displayed in Hartford, Conn., where the eccentricity of the kickers against the City Gas Light Company is either born of the assinine or is to be charged to the gentlemen who have been and are engaged in the losing game of trying to reap a profit out of supplying electric currents at prices that are inadequate to sustain the operation. Hartford, notably amongst American cities, has been for years the place where good gas was sold at low figures; still of late the daily press there has lost no opportunity to charge the Company with this, that and the other disregard of its duties and its blindness to the needs of its customers. If the complainants of and in the press merely took the trouble to visit the site of the gas works, there to look over the unique and daring plan of rebuilding the Hartford Company's plant that is being carried on by Mr. Harbison and his associates, which work has not resulted in *any* interruption to the gas supply of the city, they would cease complaining or scoffing only to give due credit to the quick life of the Company they had been reviling as slow, if not inert. However, we imagine our expression of belief that the Hartford electricians are at the foot of the kicking going on against the Hartford Gas Company is so near to the truth of their standing in the premises that we need look no further to find the other cause for objection.

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OBITUARY NOTE, THE HON. ROBERT SHERRARD.—In the quiet hours of the morning of the 8th inst. the angel of death hovered for a moment by the bedside and called from among us one of our most honored citizens, the Hon. Robert Sherrard, who peacefully passed away, surrounded by his family. He had been sick for less than a week, and all that medical science could do to save his life was of no avail.

Mr. Sherrard was born at Rush Run, Jefferson county, Ohio, June 9th, 1823, and so was in his 73d year. He was of Scotch-Irish ancestry, from whom he acquired those distinctive characteristics of the race—pluck, perseverance, and, above all, energy—which made his life so successful, and a shining mark for the younger generation.

In his earlier days Mr. Sherrard worked on his father's farm, and, in the fall of 1840, became a student in the Grove Academy, Steubenville, walking in and out from his home daily. He continued at school until September, 1845, except at the intervals when he was engaged in teaching school. In October, 1845, he began to read law, which study he pursued until October, 1848, at which time he was admitted to practice by the Supreme Court of Ohio, and began the practice of law. Later on, in 1850, he formed a partnership with the late Judge John H. Miller, and in 1861, on motion of the Hon. T. D. Lincoln, he was admitted to practice in the United States Supreme Court, being sworn in by Salmon P. Chase, then Chief Justice. In 1863 he retired from the practice of law and bought out the Mechanics Savings Bank, and commenced banking under the firm name of Sherrard & Co., the late Mr. Thos. L. Jewett, of the Pennsylvania Lines, being his partner. This firm continued until October, 1865, when he was induced, reluctantly, to change to a National Bank, continuing as its President until the fall of 1868, when he became dissatisfied, and, by consent of its stockholders, he closed up the business, paying them a premium of $60,000 on their original investment of $150,000, besides the 10 per cent. dividends that had been paid annually. On October 1st, 1868, the banking firm of Sherrard, Mooney & Co. was founded, and has since continued doing business.

Mr. Sherrard was an active business man up to the date of his sickness. In 1870, while a Director of the P. C. and St. Louis Railway Company, he was appointed Chairman of the Committee on Reorganization of the finances of that Company, and was also appointed its financial agent, with offices in New York city. He removed with his family to New York, April 1st, 1870, and shortly thereafter organized the New York Transfer Company with a capital of $600,000. He was elected its Treasurer, and, in 1873, its President and Treasurer, which positions he held until 1878—he continued on its Board of Directors until relieved by death. During his residence in New York he was elected President of the American National Bank, of New York, which position he held until he resigned, to return to Steubenville in the fall of 1877, to look after some business interest which was left without an interested party to manage its affairs, owing to the death of Col. Geo. W. McCook.

On his return to Steubenville, Mr. Sherrard was elected President of the Steubenville Coal and Mining Company, which position he held up to the time of his death. In 1879, after the death of Dr. Thomas Johnson, Mr. Sherrard was elected President of the Steubenville Gas Light and Coke Company (since reorganized into the Steubenville Gas and Electric Company), in which office death found him. In 1881 he was one of the organizers of the Steubenville Pottery Company, which has proven so successful, and is now giving employment to nearly 300 persons.

Politically Mr. Sherrard was a staunch Republican, loyal to his party. In the fall of 1861 he was elected a member of the Ohio State Senate, from the counties of Jefferson and Columbiana, and during his term of office was appointed on four of the regular committees as Chairman, which positions he filled with honor to himself and credit to his party.

He was chosen a delegate to the National Convention, at Philadelphia, which nominated Col. John C. Fremont, and was one of the committee from Ohio to wait on him in New York to inform him of the nomination. He was chosen a delegate to the Baltimore Convention, in 1864, which nominated Abraham Lincoln for his second term, and a delegate to the Chicago Convention which nominated Benjamin Harrison, in 1888. He attended all the Ohio State Conventions since 1854, and was an ardent supporter of the party.

For the past 35 years Mr. Sherrard has been honored by numerous National and State appointments, the last of which was tendered to him in 1893, when Governor McKinley appointed him a member of the Board of Trustees of the Asylum for the Insane, which is being built near Massillon, Ohio. He was elected President of the Board, and had been devoting much of his time for the past two years to the work of directing its construction.

During the civil war he rendered valuable services to the government, on the outbreak of which, in 1861, he took an active part in raising the first companies enlisted in Ohio. During his life Mr. Sherrard took an active interest in educational matters, serving for 17 years as a member of the Board of Education, and, from 1853 until relieved by death, he was a member of the Board of Trustees of the College endowment fund of the Presbyterian Church, which Board managed the affairs of Washington College, Washington, Pa.; and as a reward for his long and faithful services as Trustee of that College, the Honorary Degree of Master of Arts was conferred upon him by it in 1863.

As said in the JOURNAL a week ago, deceased was a prominent and valued member of the Ohio Gas Light Association, in the proceedings of which he always took a lively interest.

In the death of Mr. Sherrard, Ohio has lost one of its honored citizens, who could always be counted on to do what was in his power to advance the interest of the State and of his fellow man. Deceased leaves a wife and seven children, to mourn the loss of a kind husband and affectionate father, who was ever ready to give them good advice and assist them along the honored walks of life.

The funeral services, which were held on the afternoon of the 10th inst., at the First Presbyterian Church, were very largely attended by citizens in general, and also by a great many noted attendants from abroad, among whom were Governor McKinley, Secretary of State S. M. Taylor, State Treasurer-elect S. B. Campbell, and Dr. A. B. Richards, of Columbus.—J. G.

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NOTES.—The Board of Street and Water Commissioners, of Jersey City, N. J., will open bids for the public lighting of that place at 2 P.M. to-day.——The Consolidated Gas Company, of New Jersey, has assumed charge of the Long Branch works, and we think it is fair to say that the same concern is also in possession of the Asbury Park plant. If the plans for the supply of gas along the southeast New Jersey coast, as contemplated by the Consolidated Company, are carried out, the venture is certain to be a profitable one. The only handicap to this result would seem to be over-capitalization.——Mr. A. C. Humphreys is to be Manager of the gas works at Syracuse, N.Y., under the new proprietorship.

## Novelties in the Gas Lighting Field.

[Abstracted by the *Gas World*, from an article by Dr. H. Bunte, of Karlsruhe.]

During the past few months we have had the discovery of new elements in the air, the industrial production of calcium carbide and acetylene, the discovery of great quantities of the rare earths for mantles, the synthesis of lighting gas, or its carburation by benzol.

*Argon.*—The discovery of argon, when first declared, awakened considerable doubt, for so many investigators have been at work at the atmosphere for so many years. The ordinary impurities of the air were all well known; its microbes, its ozone, had all been examined; but there was no thought of there being a new element in the air which had not been found in any mineral. One observed fact had, however, put the discoverers on the track. Lord Rayleigh had found that nitrogen from the atmosphere was always heavier than nitrogen from pure nitrogen compounds. This led to the suspicion that in the atmosphere the nitrogen was really a mixture of pure nitrogen with a heavier gas; and this gas was discovered on absorbing atmospheric nitrogen with red-hot magnesium or lithium. A residue was left unabsorbed, which was a heavier gas than nitrogen; and this gas is, like nitrogen, so inert that it had always been reckoned as nitrogen in all analyses. This gas gives, in a Geissler tube, a light whose spectrum is quite different from that of pure nitrogen—it is more soluble in water. It cannot yet be said what part, if any, argon plays in a flame. It seems clear now that argon is not an allotropic modification of nitrogen, but is a genuine new element. It cannot be called a rare element, for though it makes up only 1 per cent. of the atmosphere, its total quantity is immense. Nitrogen does not exist in any primitive rocks, and is, as a rule, only found at all in minerals (such as coal) where these have been derived from some form of living being; but, most curiously, some few minerals, especially of the uranium ore order, contain both nitrogen and argon, and give them out at a red heat, or upon treatment with acids. The gas given out had hitherto always been looked upon as nitrogen. But more than that, this gas contains another gaseous element, helium, which had never been found upon the earth, and was only known as a constituent of the atmosphere of the sun.

*Rare Earths.*—Ten years ago these oxides were hardly to be seen, except as chemical curiosities, and the price of thorium was about 37 cents a grain. The minerals containing them were first investigated about the end of last century, and were mostly from Sweden. In cerite Mosander found ceria; then in the same mineral he discovered lanthania, and afterwards didymia; and afterwards a considerable number of these oxides were discovered. Their property of brilliant incandescence, when heated, has been very long known; but it was not of any particular interest until Auer von Welsbach took it up. When he had done so the minerals were found to be much more widely spread than had been supposed. Whole geological formations are found, in America, to contain them in small quantity. Monazite, which is a phosphate of cerium and lanthanum containing 2 to 4 per cent. of thoria, has been found in quantity in Connecticut, in South Carolina, in Brazil, in the Ural mountains and in Australia; and, curiously, it is mostly associated with the neighborhood of gold, so that monazite sand, which is very heavy, was quite well known to gold-dust washers. But in August of last year 65 tons of this sand was obtained in the United States alone; and the output is increasing. At first all went to the Welsbach Companies, but now there are other works which prepare the pure salts, and thus there is a market which regulates the prices. The prices of monazite have come down from 20 or 25 cents to 6 or 6½ cents per pound, and a firm in Amsterdam offers to supply 20,000 tons per annum at 9 cents per pound. At this price the mere value of the thoria in a Welsbach hood would 0.036 cent; the cost comes in in the difficulty of working up the mineral, and therefore we cannot look for any reduction in price through cheapening of the raw material. Then, is there enough raw material in sight? There would seem to be, for the quantity which the Amsterdam firm is ready to supply per annum would make 1,200,000,000 Welsbach mantles a year, which seems more than ample. We need at present smaller Welsbachs of, say, 20-candle power. These, with penny-in-the-slot meters, would give a very cheap light, and would keep down the rising price of petroleum.

In spirit Welsbach lamps, for 20 to 22 candles, the consumption per hour is about 1,200 grains of spirit of 96 per cent.; and at the price [in Germany] of 37 cents per gallon, this comes to about 0.0576 cent per hour. The lamp still needs improvement; but in it a blue spirit vapor flame acts upon an ordinary Welsbach hood. Externally it looks like an ordinary petroleum lamp, and the fittings can be screwed into the head of any such lamp. Naphtha vapor lamps and benzene vapor lamps are also made for the same purpose.

*Acetylene.*—[History given]. The Neuhausen-on-the-Rhine works and the Bitterfield works both supply carbides at 12 cents a kilogramme ($127.75 a ton). The calcium carbide is sealed up in cases of 11 to 22 pounds; the aluminum carbide, which is a powder, and is much less easily decomposable by moisture, does not need such precautions. The commercial carbide contains from 50 to 65 per cent. of pure carbide, and in all calculations this ought to be kept in view. There is in the flame no blue whatever, the gas burns at once, and this is the basis of Professor Lewes' theory [explained]. The gas can be very readily condensed, and the Mannheim Chemical Industry Company is now supplying it in the liquid form in steel cylinders. The light in this form is not very cheap, but is beautiful. For enrichment the prices of carbide and acetylene are too high; and the advantages of non-condensability, which acetylene possesses, are somewhat too remote.

*Benzol Enrichment.*—This is now a good deal employed in England and in France, as well as in Germany. It is the natural means for enriching coal gas, and, at present prices, it is still the cheapest, for it is cheaper to benzol-enrich gas from poor coal than it is to make rich gas direct. Experiments have lately been made, on the large scale, in Munich, and by the Dessau Company. In Munich the whole enrichment is now being done by means of benzol, for they find benzol cheaper to use than cannel; there is more gas to the ton, and air purification is facilitated (1 per cent.) There now seems little fear of a rise in the price of benzol. The 1 per cent. of air does not now lower the lighting power, while the purifiers last longer. The benzol is steam heated to 77° F., and 21.5 lbs. of benzol are evaporated per hour into about 25,000 cubic feet of gas. At 55.4° F. some 7½ lbs. of benzol would evaporate per hour; and at 118.4° F. about 110 lbs.; so that the supply of benzol to the gas is under prompt and ready control, which is not the least of the advantages of the process. Herr Schilling gives the above results, and says that no difficulties or disadvantages have been met with. They may be got into the gas by the most various methods; the main thing to see to is the quality of the benzol. Fifty per cent. benzol, half of which evaporates below 212° F., generally contains too much toluol, etc., the right kind to use is 90 per cent. benzol, which is, after all, not very much dearer than the other. The quality of the benzol supplied should be kept under observation by means of simple distillation tests.

## Methods of Heat Insulation.

In our issue for November 11th (page 782), under the heading "Asbestos for Pipe Covering," is given a *resume* of the discussion which followed the reading of a paper, by Mr. John A. McConnell, before the Engineers' Society of Western Pennsylvania, on the subject of "Heat Insulation, with Notes on Asbestos." From inquiries received by us respecting one or two points in the discussion, we believe the following abstracts from Mr. McConnell's paper will be of interest:

* * * Almost all the coverings now being made by reputable manufacturers are good non-conductors, and the question of their relative non-conducting power is not nearly so important as is the question of permanency.

In addition to the reputed tests so largely advertised, experiments have been carried out in the engineering department of a number of our leading colleges, to determine the heat insulating power of different classes of coverings, and the results announced have been very conflicting. Most of the tests have been by condensation, in substantially the same manner, as follows—from the main pipe there branches a number of smaller pipes of the same size and length, each insulated with a different covering; the free end of each pipe is lower than the main, and the water is drained from each and weighed to determine the relative condensation in a specified time, the condensation in the main pipe being drained off separately. A carefully conducted test at the University of Michigan, under the direction of Prof. Cooley, showed in favor of hair felt. A similar test at our Pennsylvania State College showed mineral wool to be the best non-conductor; and while I have not the report, I have been credibly informed that a test at Cornell University showed wood felt lined with asbestos paper in a favorable light. In some of these tests asbestos coverings have come out ahead, and magnesia in others.

Many of these tests have been conducted by gentlemen of reputation and honor, and were doubtless thoroughly honest. My experiments have shown that different pipes, all insulated with the same material, will at times show, by condensation tests, almost as varied results as the

college tests have shown in pipes covered with different materials. More water may be carried from the main with the steam into some pipes than into others, and there are so many things that may modify the result of such tests.

The average result of all these experiments, coupled with my continuous experience in the business these many years, and with 25 or 30 different varieties of material, convinces me that coverings can be made either of hair, wool, asbestos, wood pulp, mineral wool, infusorial earth, carbonate of magnesia, chalk, gypsum, and compounds of these and other materials, that will all be so nearly alike in non-conducting power that a slight change of condition will turn the scale for or against either.

While there is question what particular covering may save a few heat units more than some other covering, there is no question about the great difference in loss from a bare boiler as compared with an insulated one.

The experiments of Peclet give the following as the conducting power per square foot of four materials, difference of temperature 1° F.:

| | | |
|---|---|---|
| Copper..... | 515.000 | heat units per hour. |
| Iron..... | 233.000 | " " |
| Ordinary stone.. | 13.680 | " " |
| Powdered chalk. | .869, or less than 1 heat unit. | |

Hence copper conducts 593 times as much heat as the chalk, iron 268 times as much, and even ordinary stone 15 times as much; hence why should covering manufacturers quibble so much about a half dozen heat units of difference when the difference between the covering and the iron steam pipe is counted by hundreds of heat units; of course, poor non-conductors must not be used, as their necessary thickness will so increase the radiating surface as to neutralize their non-conducting power. I purposely used chalk in illustration, because it is very similar to the three materials that are being most largely used in combination with asbestos in making high temperature coverings—these are infusorial earth, carbonate of magnesia and gypsum, each dependent for its strength largely upon the asbestos incorporated with it.

Porousness is one of the necessary qualities of good non-conductors, and this porousness necessarily tends to weakness, hence clothing for steam pipes, like the clothing we wear, is liable to wear out. Means for counteracting this natural weakness and for making coverings permanent is the one thing now needed. I am thoroughly convinced that there is only one practicable way to render coverings really permanent, and that is to strengthen them by reinforcing with iron. Iron can be so incorporated in the body of the covering that the atmosphere cannot reach it; the life of iron thus protected from the atmosphere is almost unlimited, and thus situated it will hold the covering in place indefinitely, making it really permanent.

I have known this a long while, but I have never been able to introduce it to the public on account of the largely increased cost; when I increase my price enough to justify this improvement, other parties get the contracts, but the paying of this additional cost is, in the end, the very best of economy, for coverings thus strengthened with iron will last five or six times as long as any of the coverings now in general use. The iron, being protected as indicated, need not be of sufficient thickness to affect the non-conducting qualities of the covering.

A high degree of permanency is attained by using 1-inch thick of any of the well known mineral coverings, and outside of this from a half-inch to an inch of wool-felt paper, made into solid tubes and securely fastened over the mineral coverings.

Felt paper pipe coverings, while excellent non-conductors, have heretofore failed of permanency because they were placed so near the hot pipes that they were gradually burned up. With an inch of good mineral insulation next to the pipe, this charring weakness of the felt paper is entirely overcome, and the paper tubes being very strong will, if properly fastened, hold the magnesia, asbestos, or other mineral covering in place two or three times as long as it would otherwise remain.

Less than an inch of mineral under the paper will not protect it, hence this plan means substantially two coverings and adds materially to the cost, and I do not believe it is possible to make heat insulating coverings permanent without making the first cost more than it has heretofore been, but by increasing the cost they *can* be made permanent.

## The Rating and Behavior of Fuse Wires.

Prof. W. M. Stine and Messrs. H. E. Gaytes and C. E. Freeman, at the October session of the Am. Inst. of Electrical Engineers, reported some elaborate experiments on fuse wires made at Armour Institute, Chicago. In the experiments undertaken it was considered best to adopt not more than two brands of wire for all the tests, rather than to employ a large number of varieties; other investigations have shown that various makes of fuse wires closely resemble each other in behavior, and that the conclusions obtained with one wire may be accepted as true for all. In the first series of tests two classes of porcelain cut-outs were employed; one was an open porcelain or main line block, and the other of the closed porcelain or K. W. type. In the latter, which has recently been very properly condemned by the underwriters, the 10 ampere size has a space of only one-half an inch between the terminals, and a fuse blowing under 20 amperes invariably establishes a vicious arc accompanied by such an explosive violence as to frequently shatter the block. The terminals of the open block are further apart, but a pronounced fault in their construction is that the terminals are let in flush with the surface of the porcelain. In nearly all types of porcelain fuse blocks the terminals are too close together in small sizes, the fuse often rests on the top or base, and the mechanical construction is very poor.

The tests with the above two types showed their unreliability; and also demonstrated the imperfect rating of one of the two fuse wires used. In a second series of tests an open 8-inch fuse block was adopted to avoid all cooling effects from the terminals. The tests showed a great variation in the time of blowing.

The blowing of a fuse is stated to be not immediately an electrical act. The current fuses the metal, the cross section is reduced at son e point due to gravity, unequal expansion and sweating; the heat in consequence intensifies at this point, and a globule falls, breaking the circuit and establishing an arc which soon burns out the fuse.

It was found that fuse wire of small diameter more nearly approaches the ideal condition, and recommended that to guard against excessive currents of short duration, such as motors are subject to when operated on street railway and power circuits, multiple fuses be used; a fuse of four pieces of 5 amperes each would, for example, prove two or three times as sensitive as one piece of 20 amperes. As the sluggishness of large fuse wires may be due to the action of the outer layers, which, with the oxide coating, prevents the fuse from breaking, a thin ribbon should prove more sensitive than a round wire.

Tests with long lengths of wire revealed some actions which may account for the lowering of the fuse point by use. In one wire, with the current just below the fusing point, the fuse was found to "sweat" and the oxide film broke in places to allow the molten interior to ooze out. When the current was shut off, the globules were drawn in, leaving the wire pitted. A second fuse wire was found to be remarkably plastic and free from an oxide film, but it sagged badly and twisted, showing a high coefficient of expansion; as a result it was drawn out and the cross-section reduced. When used vertically the metal floated until a large globule formed, a rupture occurring just above this. In the case of German silver fuses, the sweating resulted in partially breaking up the alloy, the zinc seeming to melt out from the nickel and fusing with the copper, forming globules of brass. This was so marked that it would render such fuses too uncertain for use in all but the smallest diameters of wires.

The experiments showed that the usual rating of fuse wires in ampere carrying capacity is practically valueless and should be discontinued. The proper designation for such wires would be a table of carrying capacities for the lengths ordinarily employed. For example, a 10-ampere wire 8 inches long fused in 30 seconds, with 15 amperes; with 35 amperes in a length of one-half inch in a covered fuse block; and with 25 amperes in an open block with a length of $\frac{1}{4}$th of an inch. Accompanying each spool of one of the wires was a stated carrying capacity for a given length, but this is not sufficient, for it furnishes no guide for other lengths.

Copper fuses were found to be more sensitive than alloy fuses; in the tests they reached a red and even white heat, while the other fuse wires scarcely reached a perceptible glow. Metals in general which can be worked to a nearly white heat will prove more sensitive, since the slight increase of heat will make them highly fluid, and ruptures will promptly occur. The practice, therefore, of using copper in street railway circuits for limiting the fuses seems justifiable. The tests in general showed the desirability of working fuses at a red heat for normal maximum loads, but this is declared to be a question that must eventually be left for the underwriters. German silver was found to offer no advantages in large sizes, and it deteriorated more rapidly than any other wire tested. A copper fuse inclosed in a fiber tube is recommended for electric lighting and power circuits.

In testing the influence of fatigue on a wire, long lengths of two different fuse wires had a current passed through them for seven hours,

and it was found that one experienced a positive and the other a negative fatigue. It was found that nothing was gained by cleaning fuse wires, but rather that the thin film of grease deposited during the drawing of wire was rather an advantage. It is added, however, that some coating not affected by heat, and reducing radiation, would doubtless increase the stability and sensitiveness of fuse wires.

A singular phenomenon was noticed when 8-inch test pieces of one of the wires were blown horizontally in a test block. The arc would usually occur at the same place near the center of the fuse, and when the time was within six seconds the entire piece would be shattered into approximately equal lengths, varying from ¼ to ½ of an inch, according to the current employed. The length of these pieces varied with the strength of the current, and the uniformity of the results was noticed throughout the tests. The entire fuse to within a short distance of the terminal seemed to explode into fragments simultaneously with the formation of the arc. Practical conclusions of the tests are given as follows:

1. Covered fuses are more sensitive than open ones. 2. Fuse wire should be rated for its carrying capacity for the ordinary lengths employed. When fusing a circuit, the distance between the terminals should be considered. 3. On important circuits, fuses should be frequently renewed. 4. The inertia of a fuse for high currents must be considered when protecting special devices. 5. Fuses should be operated under normal conditions to insure certainty of results. 6. Fuses up to 5 amperes should be at least 1¼ inches long, one half inch to be added for each increment of 5 amperes capacity. 7. Round fuse wire should not be employed in excess of 30 amperes capacity. For higher currents flat ribbons exceeding 4 inches in length should be employed.

## The Electric Lighting Plant of the Philadelphia Main Station, P. & R. R. Co.

A feature of the technical sessions of the last annual convention of the American Society of Civil Engineers was the paper, by Mr. Joseph M. Wilson, C.E., the theme of which was the "Philadelphia and Reading Terminal and Station in Philadelphia." The author, who treated his topic in a most exhaustive manner, had the following to say respecting the electric lighting of the yards and the mammoth station structure:

*Arc Lighting Plant.*—The arc light plant has a total capacity for operating 300 2,000 nominal candle power arc lamps in 10 circuits, with a maximum of 30 lamps on each circuit. The lamps in the train shed are suspended over each platform, at distances apart of 50 feet, with the arc 16 feet above the floor. The conductors run across the shed, 28 feet above the floor, and are stayed over the center of each platform from the front to the rear of the shed with phosphor-bronze wires of No. 12 B. and S. gauge. The lamps on the line of the road are erected on poles, with the arc placed 30 feet above the track level, and between Arch and Callowhill streets are spaced generally 100 feet apart on each side of the road. The lamps are located so as to also illuminate the streets passing under the road. On the branch lines the lamps are located on the right of the outbound track, at distances apart of about 125 feet.

The tracks are served by five circuits, but the lamps are so connected that two of the circuits may be cut out and yet leave a sufficient number of lamps in service to operate the road. The poles for the road lines are of Michigan pine, 5 inches square at the top and 10 inches square at the level of the roadway, those between Arch and Callowhill streets being set either in wrought iron pedestals or secured by iron clamps to the masonry, and those on the branch lines set 7 feet in the ground, on large flat stones and well tamped. The poles are dressed and painted in three coats of white lead and oil, and are provided with iron ladders. The conductors are carried up the poles in moldings, and each lamp is provided with a cut-out switch in a cast iron box with Yale lock, set 4 feet above the track, and so arranged as to cut out the lamp without breaking the circuit of the other lamps. All of these lamps on the roadway have clear glass globes.

The electrical conductors go out on the right and return on the left side of the roadway, those between Arch and Callowhill streets being laid in 1¼-inch wrought iron pipes, either on the coping or under the surfaces of the ground. Brass slip joints are provided for expansion and contraction and cast iron junction boxes at each lamp. On the iron elevated construction the conductors are carried under the footways on glass insulators. All lamps are suspended independently from the conductors.

There are 10 direct current automatic Western electric arc dynamos, each having a capacity of 30 10-ampere 50-volt lamps, at a speed of 1,400 revolutions per minute. The dynamos are operated by five Westinghouse compound engines (one engine driving two dynamos), connected up with Shultz endless leather-link belts. Each engine has 10 and 18 by 10-inch cylinders, and is rated at 65-horse power. The switchboard is of Tennessee marble, and is fully equipped with spring jacks, plugs, ampere meters, lightning arresters, magneto bell, voltmeter, etc. The lamps are 2,000-candle power of two carbon Western Electric manufacture. All conductors are of No. 4 B. and S. gauge; those in the underground conduits have simplex triple-braided double extra mining insulation, and those for all other work, triple-braided weather proof insulation.

*Incandescent Electric Light Plant.*—The incandescent electric light plant is served by both alternating and direct current dynamos. The alternating current apparatus is located in the Cherry street power house and serves the lights in the power house, the market offices and toilet rooms, the cold storage rooms, the tunnels and basements, the kitchen, restaurant, express rooms, station master's office and relay lamps in the passenger corridor; also two 500-light (equivalent to 1,000 16-candle power lamps) converters in the headhouse engine room.

There are two 45-kilowatt Westinghouse alternating current incandescent dynamos with separate exciters driven from the engines, each exciter having a capacity of 30 amperes at 125 volts, the primary current being 1,000 volts and the secondary 100 volts. Each dynamo is driven by a Westinghouse compound engine, rated at 100 horse power, with 100 pounds steam pressure.

In addition to the various circuits serving the lamps as indicated, a pair of No. 4 B. and S. mains is run to the 1,000 light converters, which are connected with the headhouse distribution switchboard and act as a relay to the direct current incandescent dynamos, as will be hereinafter described.

The direct current incandescent lighting apparatus serves all lamps in the headhouse, the motors driving the ventilating fans and the transformers serving current for all the telegraph lines centering in the building. There are three Westinghouse 75 kilowatt multiple, direct current incandescent light dynamos, each of 600 amperes, at 125 volts. Each of these dynamos is driven by a Westinghouse compound engine of 125 nominal horse power.

The switchboard is of white marble, 18 by 9 feet, supported by brass pedestals. It has two pairs of bus-bars, one pair for alternating current and the other for direct current. The 36 circuits serving the building are each provided with a double pole, double throw, jaw switch, and four spare switches are supplied for additional circuits that may be needed. Each circuit is furnished with two cut-out switches on each pole, so that in the event of the failure of a fuse a second fuse can be thrown into circuit by the closing of the auxiliary switch. Each of the circuit switches is connected to both sets of bus-bars, so that when thrown up they feed the circuits from the direct current bus-bars, and when thrown down from the alternating current bus-bars.

There are provided upon the switchboard for each dynamo its appropriate switches, rheostat, ammeter, voltmeter, and upon the top of the board an ammeter indicating the load on the alternating current dynamos in the power house. This arrangement of the switchboard is somewhat novel, and was so designed as to utilize the spare power of the alternating current machines and avoid the necessity of a spare direct current dynamo.

There are also provided four revolving transformers of different sizes, taking the current at 100 volts from the switchboard and transforming it to 6 volts, 20 volts and 70 volts respectively, for the operation of all the telegraph lines in this building belonging to the road and its connections.

There are installed in all, including current for motors, an equivalent of 4,200 16-candle power lamps. For general illumination one 16-candle power lamp is allowed for 1,000 cubic feet of content, which of course does not include special desk lighting. The entire wiring is run on the 2-wire system. No wires less than No. 14 B. and S. gauge are used, and wires of No. 8 and larger sizes are stranded. The insulation is as follows: Simplex double extra mining for high tension alternating currents, primary circuits. For the secondary circuits, Bishop double coat. For the direct current incandescent wiring fire and weather-proof insulation is used.

The general layout is figured for 16-candle power 100-volt lamps, on a basis of 1.2 amperes per lamp, with a loss not exceeding 5 volts, and a difference of 1 per cent. between any two lamps on the same circuit, with all lamps burning.

The conductors are run in brass armored conduits for all rooms below the third floor, but above that they are run in molding, this method

having been adopted to enable the ready change in position of lamps, as might be required to suit the various office requirements.

The attic is served with one circuit, and the third to seventh stories inclusive are each served with two main circuits, the feed wires being carried in vertical cabinets, one in the center of the eastern half of the building and the other in the western half. Each main feed wire serves a "crib," run on the ceiling of the central corridor, from which taps are made with link-fuse cutouts. Each stairway has its own circuit, which also carries lamps for the ends of the corridors. Circuits for the remaining lamps are arranged so as to admit of easy control by the engineer, and the switches and cutouts in those portions of the building open to the public are set in metallic boxes, flush with the walls, and provided with Yale locks.

## Robert's Improved Water Gas Apparatus.

On the 5th inst. U. S. Letters Patent (No. 549,156) were granted to Mr. George J. Roberts, of Philadelphia, Pa., for an improved water gas apparatus—the inventor subsequently assigned his title in the patent to the United Gas Improvement Company. Using the words of the specification :

My invention relates more particularly to water gas apparatus in which reversals are or may be made in the direction of the operations carried on in the generator, or, in other words, in which both up and down runs may be made.

The principal objects of my present invention are, first, to obviate jamming or sticking of the valves which are employed for effecting the requisite reversals of the operations carried on in the generator and to provide reliable, durable and efficient means for simultaneously lifting or opening one and depressing or closing the other of said valves without exerting any appreciable sidewise pressure or stress upon their valve spindles, and, second, to compensate for any sidewise or lateral pressure or stress that may be exerted upon the valve spindles by their elevating and depressing mechanism.

My invention consists in the improvements hereinafter fully described, and particularly referred to in the claims.

Ths nature, characteristic features and scope of my invention will be more fully understood from the following description, taken in connection with the accompanying drawings, forming part hereof, and in which—

Figure 1 is a side elevational view, partly in section, of a well known type of generator and fixing chamber having pipes or conduits leading from the top and bottom of the generator to the fixing chamber and and each provided with a slide or gate valve, showing mechanism embodying features of my invention for simultaneously opening one and closing the other of said valves without bending or jamming their spindles. Fig. 2 is a sectional view looking toward the left and taken on the line 2 2 of Fig. 1 in order to illustrate a side elevation of the mechanism comprising my invention. Fig. 3 is a top or plan view of the valve actuating mechanism illustrated in Figs. 1 and 2, and Fig. 4 is a view similar to Fig. 2 and illustrating a modification of my invention.

In the drawings, 1 and 2 are pipes, flues or conduits connecting the upper and lower portions of a generator 3 with a fixing chamber 4 and provided with slide or gate valves 5 and 6, having operating spindles 7 and 8. These valves 5 and 6 are used for causing a reversal of the processes carried on in the interior of the generator 3, or, in other words, for effecting so-called "up and down runs." For this purpose one of the valves must be opened as the other is closed. According to my invention, this result is accomplished by means of linkwork and so-called "floating levers" or by means of sprocket chain and wheels.

In the accompanying drawings, the valve spindle 8 is provided upon one of its faces or sides with teeth constituting a rack, and is afforded a range of endwise play or movement through a stuffing box 9 and through a slot or guide opening 10, Fig. 3, in a yoke 11, secured in the present instance to the casing of the valve 6.

12 is an arbor or shaft journaled in the yoke or bracket 11, and provided with a handwheel 14 and with a pinion 13, meshing with the rack of the valve spindle 8. The rotation of the handwheel 14, acting through the instrumentality of the rack and pinion, causes power to be applied directly to the valve spindle 8, so that the valve 6 may be lifted and depressed by turning the handwheel in one direction or the other, as required. During this operation the stuffing box 9 and guide slot 10 support the valve spindle 8 at two points against sidewise or horizontal thrusts of all kinds, and thus prevent the pinion 13 from bending the spindle, whereby jamming and sticking of the latter and of the valve are obviated.

Referring more particularly to Fig. 2, a description will now be given of one type of mechanism or combination of linkwork adapted to cause the valve 5 to be closed when the valve 6 is open, and to cause the valve 5 to be open when the valve 6 is closed. The part 15 is pivotally supported by a rocker arm 16, carried by the valve casing or its equivalent, and constitutes a floating lever. Motion is imparted to this floating lever 15 directly from the valve spindle 8, to which it is jointed or pivotally attached. One extremity of a rod 17 is pivotally attached or jointed to the floating lever 15, and the other extremity of this rod is pivotally connected with a second floating lever 18, pivotally connected with the valve spindle 7 and carried by a rocker arm 19, jointed or pivoted to the casing of the valve 5 or its equivalent. If desired, a counterweight 20 may be employed for facilitating the movement of the parts, and one of the floating levers 15 and 18 may be connected with a block, as 21, adjustable endwise of the link 17, whereby the throw of the mechanism may be increased or diminished in order to accommodate it to valves of different dimensions. The mode of operation of this linkwork may be described as follows: A counter clockwise rotation of the hand wheel 14, acting through the instrumentality of the rack and pinion 13, causes the valve spindle 8 and valve 6 to be elevated. During this movement the valve spindle 8 is guided by the stuffing box 9 and by the slot 10, so that any horizontal or sidewise thrust that may be exerted by the pinion 13 or otherwise is prevented from bending the valve spindle, because the latter is guided against horizontal displacement at two points sufficiently separated from each other. The elevation of the valve spindle 8 imparts motion directly to the floating lever 15 and causes it to push the rod 17 downward, and the downward motion of the rod 17 imparts motion to the floating lever 18 and causes it to push the valve spindle 7 downward. During this movement of the parts the rocker arms 16 and 19 constitute, as it were, moving fulcra for the floating levers 15 and 18, whereby the latter are not only turned, but also permitted to move bodily, so that approximate parallelism of vertical motion of the spindles 7 and 8 is insured. However, any lateral thrust that may be exerted by the floating lever 18 is prevented from bending the valve spindle 7, because the latter is supported by a slot 22 in the yoke 23 and by the stuffing box 24 of the valve 5. Obviously a clockwise rotation of the handwheel 14 causes the valve 6 to be opened and the valve 5 to be closed.

Referring now to Fig. 4, the spindles of the valves 5 and 6 are each provided with a rack, pinion, yoke and arbor or shaft like those above described in connection with the valve 6. In this instance the pinion of the valve 6 is operated by means of a handwheel 14, provided with a sprocket wheel 25, which transmits motion through the intervention of a sprocket chain 27 to a sprocket wheel 26, keyed or otherwise secured to the shaft or arbor 12 of the valve 5.

As illustrated in Fig. 4 of the drawings, the sprocket chain 27 is not crossed, so that the sprocket wheels 25 and 26 are both rotated in the same direction, and the required difference of direction of motion of the valves 5 and 6 is accomplished by placing the racks of the spindles of these valves upon opposite sides of their respective pinions 13, as shown.

The mode of operation of the device illustrated in Fig. 4 may be described as follows: When the handwheel 14 is rotated in a counter clockwise direction, the rack and pinion 13 cause the elevation of the valve 6, and the sprocket chain 27 imparts rotary motion to the arbor or shaft 12, whereby its rack and pinion 13 cause the valve 5 to be closed or depressed. Obviously a clockwise motion of the handwheel 14 causes the valve 6 to be closed or depressed and the valve 5 to be elevated or opened. During the operation of opening and closing the valves the stuffing boxes 24 and 9 and slots 10 in the yokes support the spindles and prevent their being bent by any sidewise thrust that may be exerted upon them by the pinions 13. The absence of any tendency to bend the valve spindles is important, because if the spindles should be bent they would become jammed and thus cause the valves to stick, whereby the apparatus as a whole would be rendered inoperative.

It will be obvious to those skilled in the art to which my invention appertains that modifications may be made in details without departing from the spirit thereof. Hence I do not limit myself to the precise construction and arrangement of parts herein above set forth and illustrated in the accompanying drawings; but what I claim as new, and desire to secure by Letters Patent, is—

1. The combination of pipes or conduits respectively provided with similarly disposed slide or gate valves, a pair of floating levers disposed respectively above and connected with the spindles of said valves and whereof one is centrally pivoted or supported, and a link or rod con-

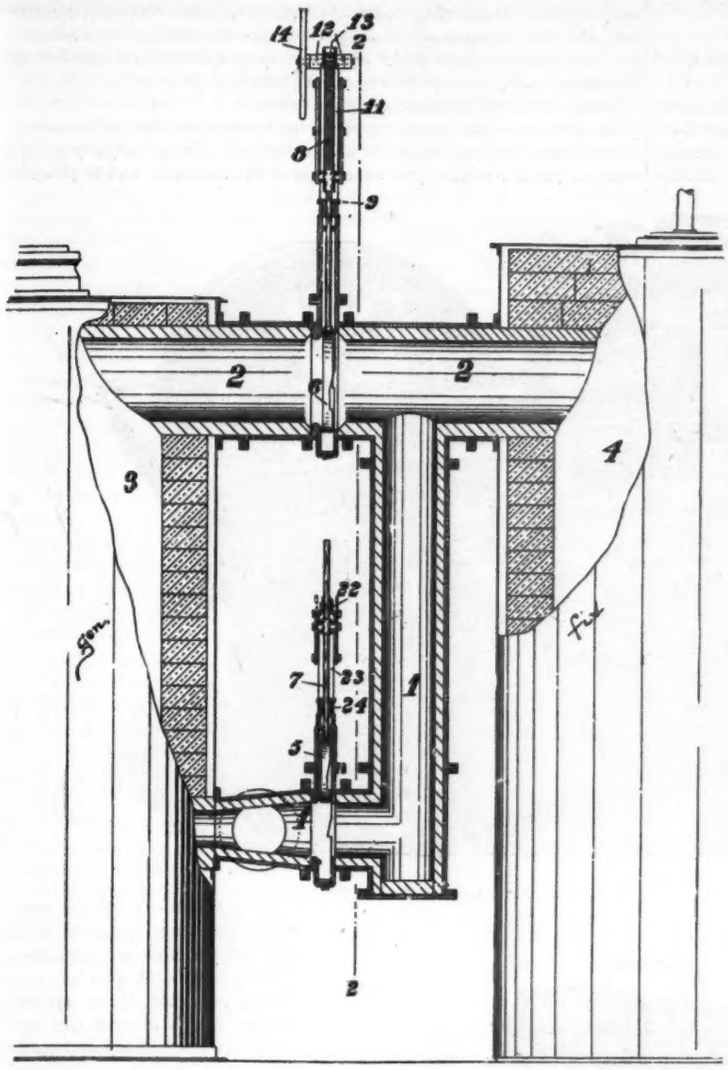


Fig. 1.

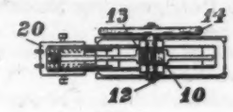


Fig. 3.

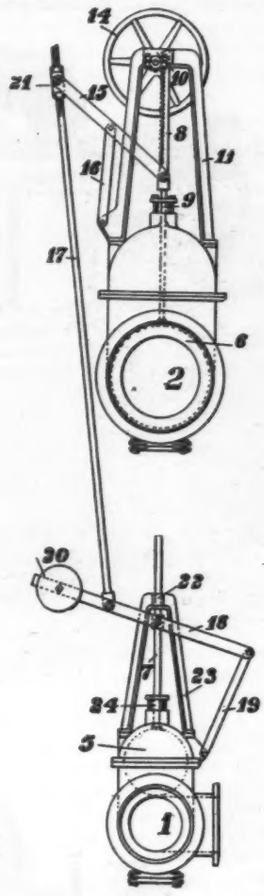


Fig. 2.

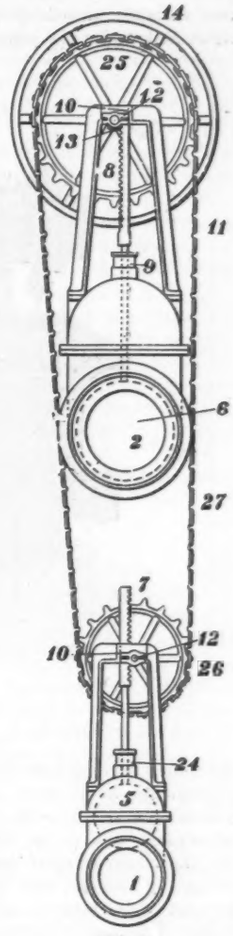


Fig. 4.

nected with one end of the centrally pivoted lever and operated by the movements of one of the valves, substantially as described.

2. The combination of pipes or conduits respectively provided with similarly disposed slide or gate valves, a floating lever supported or pivoted at its end and disposed above and connected with one of said valves, a centrally pivoted floating lever disposed above and connected at or near one of its ends with the other valve, and a link or rod connected with the other end of the last mentioned lever and with the first mentioned valve, substantially as described.

3. The combination of pipes or conduits respectively provided with similarly disposed slide or gate valves, floating levers disposed above and connected with said valves, and a link or rod for transferring motion from one valve to the other, substantially as described.

4. The combination of a pair of slide or gate valves each having an operating spindle, a stuffing box, and a slotted yoke for guiding each of said spindles, a pair of floating levers respectively connected with said valve spindles and of which one is centrally pivoted, a rod connecting said floating levers, and means for imparting motion to one of the valve spindles, substantially as described.

5. The combination of a pair of similarly disposed slide or gate valves having spindles whereof one is provided with a rack, a slotted yoke and a stuffing box for guiding each of said spindles, a pair of floating levers respectively connected with the spindles of said valves, a rod connecting said floating levers, and a handwheel for actuating a pinion meshing with said rack, substantially as described.

6. The combination of a pair of slide or gate valves each having an operating spindle, a stuffing box and a slotted yoke for guiding each of said spindles, a pair of floating levers respectively connected with said spindles and a link connecting said floating levers and adjustably attached to one of them and adapted to elevate one and depress the other of the valve spindles, substantially as described.

7. The combination of a pair of slide or gate valves each having an operating spindle, a stuffing box and a slotted yoke for guiding the same, a pair of floating levers respectively connected with said spindles, a link connecting said floating levers, a counterweight attached to one of said floating levers, and means for elevating and depressing one of the valve spindles whereby the other is depressed when the first is elevated, and is elevated when the first is depressed, substantially as described.

8. The combination of a pair of similarly disposed slide or gate valves each having an operating spindle, a stuffing box and slotted yoke for guiding each of said spindles, a pair of floating levers respectively connected with said spindles and whereof one is pivotally supported intermediate of its ends, and a rigid link connecting said floating levers, substantially as described.

9. The combination of a pair of slide or gate valves whereof one is provided with a rack, mechanism for simultaneously elevating one and depressing the other of the pair of spindles, a slotted yoke or bracket, and a stuffing box for guiding each of said spindles and for insuring parallelism of motion of said mechanism, and a handwheel for actuating a pinion meshing with said rack, substantially as described.

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Mr. Walton Forstall has succeeded Mr. F. N. Morton in the dual post of Manager and Superintendent of the Lockport (N. Y.) Gas and Electric Light Company.

## Carbonic Anhydride Refrigerating Machines.

[A paper read by Mr. E. Hesketh, M. Inst. C.E., before Section G. of the British Association.]

In 1889 the author, in conjunction with his co-directors in the Company of J. & E. Hall, Limited, of Dartford, Kent, introduced their first carbonic anhydride ($CO_2$) machine, which was made to the designs and under the patents of Mr. Franz Windhausen, of Berlin.

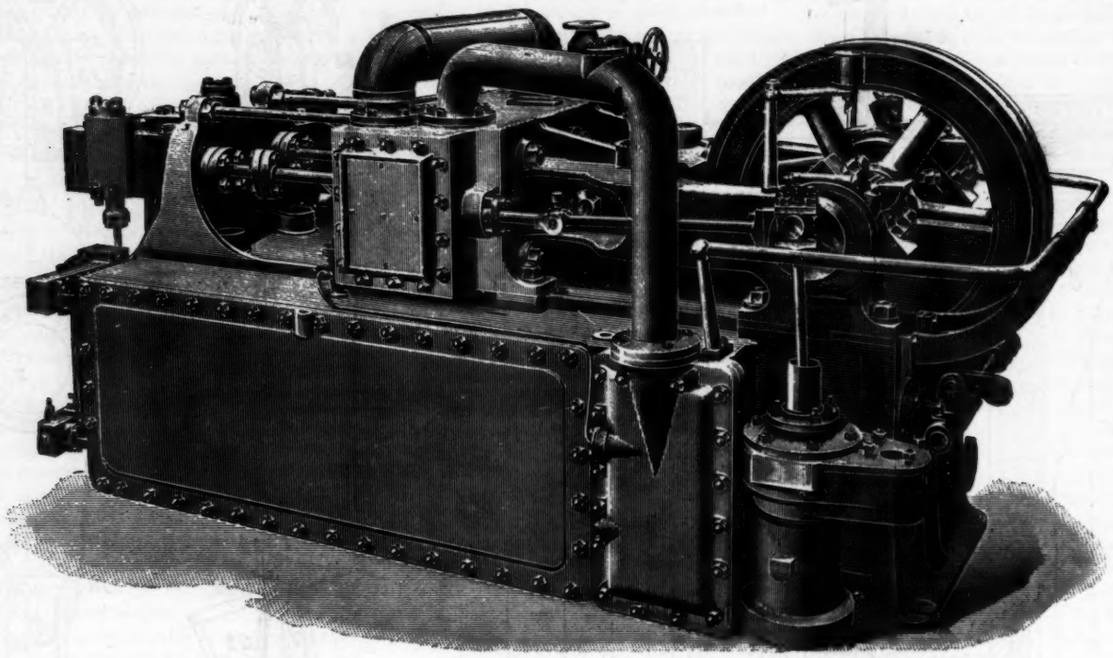


Fig. 3.

Since then very considerable improvements have been made, and the system is now so firmly established, and so far beyond the experimental stage (as evidenced by the fact that during the past twelve months 129 machines of all sizes have been supplied by the author's Company), that the author ventures to think a description of this most modern type of refrigerating machine may be of interest to this Association.

In common with many other refrigerating machines, the principle of action is the vaporization of a volatile liquid at a temperature below that of the material to be cooled, the latent heat necessary for vaporization being obtained from such material which is thereby cooled. The resulting vapor is then recompressed and brought back into the liquid state, thus completing the cycle.

The essential parts of a machine are:

An evaporator, consisting of lengths of pipe, inside which the carbonic acid evaporates, absorbing heat from the material to be cooled, which surrounds these pipes.

A compressor, in which the carbonic acid vapor is recompressed to such pressure as may be required to liquefy it at the temperature of the cooling water available; and the condenser, consisting, like the evaporator, of lengths of pipe containing the carbonic acid, and outside which circulates the cooling water, which carries off the latent heat given out during the liquefaction (Fig. 1).

Some details of the machine are as follows:

*Compressor.*—The compressors for the large machines are bored out of solid steel forgings, partly to secure strength, but principally on account of greater certainty of soundness of the material, and to provide a perfect bore in which may work the cup leathers with which the pistons are provided.

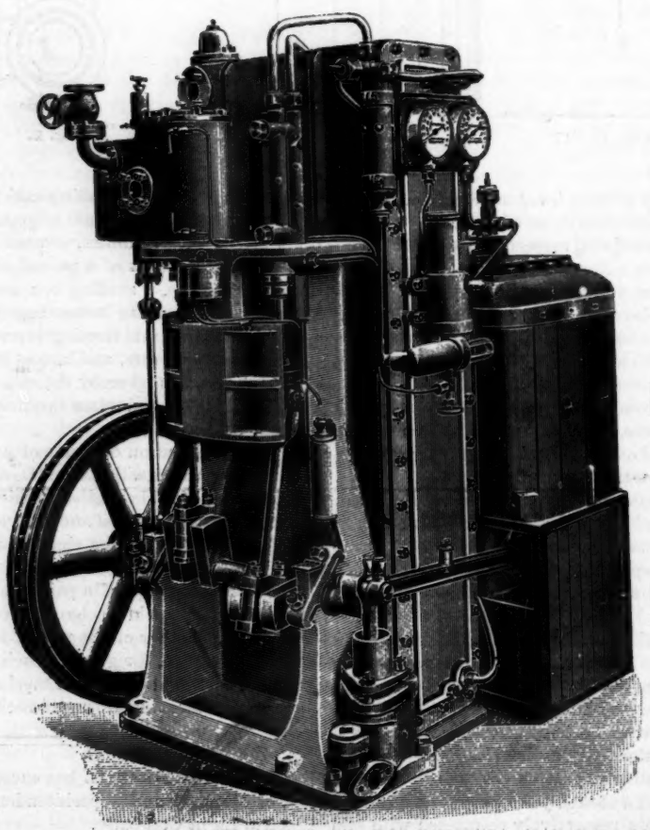


Fig. 5.

Compressors of smaller machines are cast in a special bronze, which secures the two essentials of soundness and hardness. The suction and delivery valves are identical for facilities of interchange, and are made as shown by the samples on the table.

*Gland.*—The gland is made gas tight by means of two cupped leathers on the compressor rod. Glycerine is forced into the space between these leathers at a pressure superior to the greatest pressure in the compressor, so that whatever leakage takes place at the gland is a leakage of glycerine either into the compressor or out into the atmosphere, and not a leakage of gas. What little leakage of glycerine takes place into the compressor is advantageous, inasmuch as it in the first place lubricates the compressor, and in the second place it fills up all clearances, thereby increasing the efficiency of the compressor.

The method of obtaining this superior pressure consists of the following device: A bored cylinder is fitted with a piston, and connected with one end of this piston is a rod which passes through a gland in one end of

the cylinder. From the other end of the cylinder a connection is made to the $CO_2$ condenser whereby the condenser pressure is exerted on the plain end of the piston. Into the cylinder on the gland side of the piston is forced glycerine. Owing to the difference in area of the two sides of the piston, a greater pressure per square inch of glycerine is required to keep the piston in equilibrium. A connection is made from the glycerine space to the space between the leathers in the compressor gland.

In order to replace the glycerine which leaks out of the glycerine lubricator, there is a small hand hydraulic pump, a few strokes of which are required to be made every four or five hours, as may be indicated by the position of the glycerine piston rod. This form of gland is now in constant use on nearly 300 machines supplied by the author's company.

*Separator.*—Any glycerine which passes into the compressor, beyond what is necessary to fill the clearance spaces, is discharged with the gas through the delivery valves. In order to prevent this passing into the condenser coils, all the gas is delivered into a separator and made to impinge against the sides of this vessel. The glycerine adheres to the sides and drains to the bottom of the vessel, whence it is drawn off from time to time; meanwhile the compressed gas passes off by an opening at the top on its way to the condenser.

It may here be remarked that glycerine has no affinity for $CO_2$; hence it undergoes no change in the machine, and there is therefore no fear of the coils becoming clogged by any small amount of glycerine which might be carried over in spite of the separator.

*Condenser.*—This consists of coils of wrought iron hydraulic pipe, usually of $\frac{1}{2}$-in. bore, which are either placed in a tank and surrounded by water, or are arranged so that water trickles over them, forming the well known atmospheric condenser. These coils are welded together into such length as to avoid altogether any joints inside the tank, where they would be inaccessible. The welding of these pipes is, by the way, performed in the author's works by the electrical method, which gives very good and reliable results.

In connection with the condenser one very important advantage of $CO_2$ machines is apparent, for as $CO_2$ has no chemical action on copper, in numerous cases where sea water only is available for condensing purposes, that metal is used in the construction of the coils.

*Evaporator.*—This also consists of nests of wrought iron hydraulic pipes welded up into long lengths, inside which the $CO_2$ evaporates. The heat required for evaporation is usually obtained either from brine surrounding the pipes, as in cases where brine is used as the cooling medium, or else from air surrounding the pipes, as in cases where air is required to be cooled direct.

Between the condenser and evaporator there is a regulating valve for adjusting the quantity of the liquid $CO_2$ passing from the condenser.

*Safety Valve.*—In order to enable the compressor to be opened up for examination of valves and piston without loss of $CO_2$, it is necessary to fit a stop valve on the suction and delivery sides, so as to confine the $CO_2$ to the condenser and evaporator. It is, of course, possible for a careless attendant to start the machine again without opening the delivery valve, and in such case an excessive pressure would be created in the delivery pipe, from which there would be no outlet. To provide against this danger a safety device (Fig. 2) is adopted, consisting of an ordinary spring safety valve, at the base of which is a thin copper disc, which is designed to burst at a pressure of 1,950 lb. This disc is made perfectly gas tight, an object which could not be attained by the spring safety valve alone, and the latter only comes into play when the disc is ruptured. Great care is necessarily exercised in making the discs to provide against variation in strength due to any variation either in the thickness or hardness of the copper sheets out of which the discs are made, and it is the practice at the author's works to test every disc by hydraulic pressure up to 1,350 lb., and to burst one disc in every 12, recording the pressure at which it is ruptured.

*Joints.*—With regard to the joints to withstand the high pressures, those which are not subject to a high temperature can be made absolutely tight with any suitable material, such as leather, but with the hot joints trouble was at first experienced in getting a material to withstand the heat, and also with the necessary elasticity to insure the joint being perfectly tight, not only when it is hot, but also when it is cold. This has been entirely overcome by the adoption of jointing rings turned out of a copper alloy, which completely fulfils the requirements of the case. The absolute tightness of all joints is effectually tested by brushing them over with soap and water, the slightest leak being thereby detected.

*Testing Parts.*—Very careful tests are carried out by the author's company to insure perfect soundness of all parts subject to the gas pressure. The working pressure varies, as shown by the lower curve on Fig. 12, from about 750 lb. per square inch in temperate climates, with water at 50° F., to about 1,125 lb. with water at 84°, as is usual in the the tropics. This is, of course, sometimes exceeded in exceptionally hot localities. Owing to the very small diameter of all parts, even in large machines, there is no difficulty in securing a very ample margin of strength. All parts of machines subject to the pressure of the $CO_2$ are, in the first place, tested for strength by hydraulic pressure to 3,000 lb. per square inch, and they are then again tested while immersed in warm water by air to 1,350 lb. per square inch, whereby the slightest porosity which might exist in any of the materials is at once detected by air bubbles ascending through the water.

The machines are made in 37 different sizes and designs to suit the various requirements, and several of these desigs are shown by Figs. 4 and 6, and by the engravings in part section.

The large single-type machines are usually arranged with compound steam cylinders arranged tandem, and driving by a tail rod the $CO_2$ compressor, the tanks containing the condenser and evaporator being separate from the machine.

The large duplex-type machines are arranged with triple expansion engines, the high and intermediate cylinders being on one side, and the low pressure cylinder on the other, and two compressors are driven by tail rods from these cylinders. In connection with each $CO_2$ compressor is a condenser and evaporator, so that there are two quite complete and independent $CO_2$ systems; the steam condenser is arranged in the front part of the bed.

The smaller duplex-type machines are similar to the above, but with compound steam cylinders, and the $CO_2$ condenser coils are fitted in the bed of the machine, making a compact arrangement (Fig. 3).

The small vertical marine-type machine is illustrated by Fig. 4 and by Fig. 5, and consists of a single vertical steam cylinder with compressor arranged alongside of it, both secured to a casting which contains the condenser coils, which are made of copper, and behind this casting is another secured to it, containing the evaporator coils, the whole making a very compact and accessible design.

The smaller land-type machines are shown by the sectional engraving (Fig. 6), and consist of a rectangular cast iron tank on which is cast the frame carrying the compressor. Inside the rectangular tank are the condenser coils, and inside them again is a double tank with insulation between, and the evaporator coils in the center. This type of machine is sometimes arranged with horizontal steam engine attached at one side of the main casting and driving on to the end of the crankshaft.

In all designs the condenser and evaporator coils are made of long lengths of pipe without joint, so that there are no joints whatever inaccessible.

*Performance of Machines.*—The duty of all refrigerating machines varies with the range of temperature through which the agent is caused to pass in its cycle. Thus the British thermal units abstracted by a machine of given size will be greater the less the range of temperature, and *vice versa*, and this variation in efficiency varies with different materials used as the refrigerating agent.

Trials of one of three machines erected to the order of Mr. Frank Wilson at Messrs. Combe's brewery in London, gave the following results:

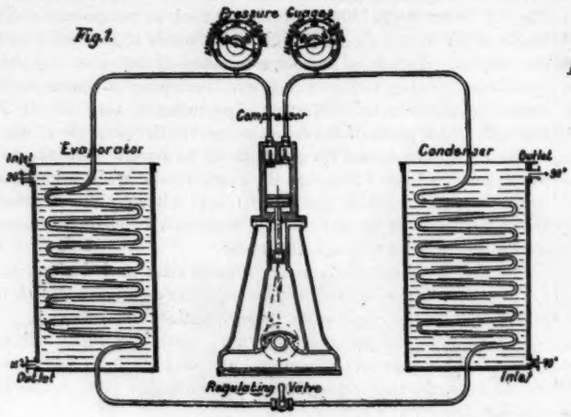
Each machine has one double acting steel compressor, and the motive power consists of a single cylinder steam engine, 15 in. in diameter by 24-in. stroke the compressor piston being driven by a tail rod. When running at 65 revolutions this machine eliminated 519,795 British thermal units when cooling water from 64.6° F. to 56.65° F. The initial temperature of the water used in the condenser was 64.4° F. and the outlet 77.55° F.—a considerable rise due to the restricted quantity of water used.

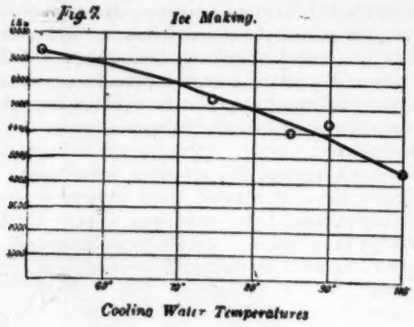
The indicated horse power of the steam cylinder was 37.13, but from this has to be deducted the power required for driving a water pump estimated at 3.128.

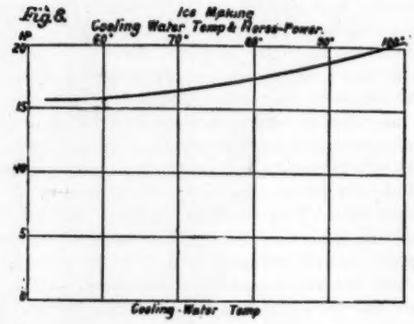
The engine is non-condensing, working with a steam pressure of 60 lb., and a back pressure of some 5 lb. above the atmosphere, the waste steam being used for heating, so the size of cylinder is larger than would ordinarily be required for the duty obtained.

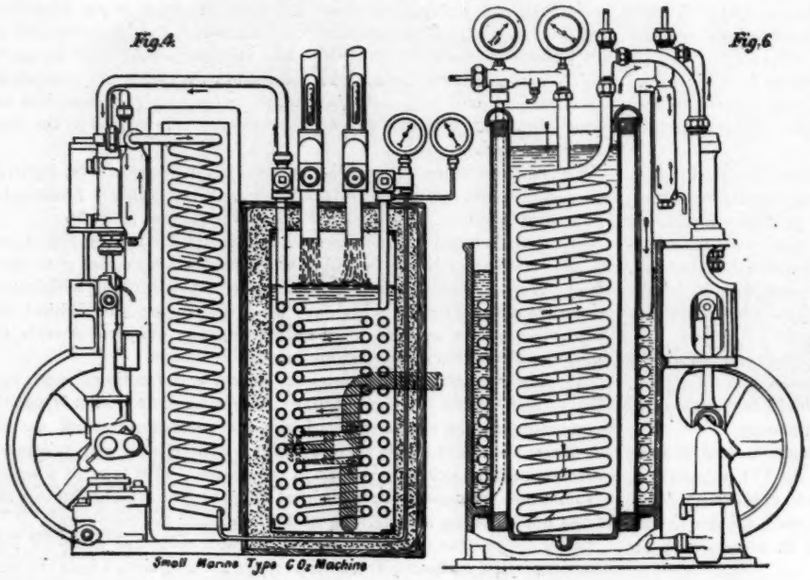
It is to be noted that the figures are obtained from a machine in ordinary work, and not from one specially arranged for testing purposes. No doubt stirring gear in the condenser and evaporator, to cause greater rapidity of flow of water over the coils, would increase the efficiency.

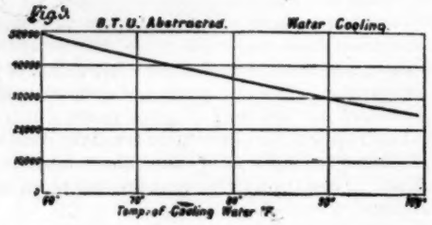
Several tests were made at different times of a nominal 4-ton ice machine, the first machine made by the author's company in 1889. The machine was tested making ice with the inlet cooling water at five different temperatures, viz., 52°, 75°, 85°, 90° and 100° F. Each test extended






over some days, during which careful records were kept, the ice accurately weighed, and the steam engine indicated. The following is an epitome of the results obtained :

| Inlet Cooling Water. | Ice Produced per 24 Hours. | Indicated Horse Power of Steam Engine. |
|---|---|---|
| 52° | 9,360 lb. | 15.62 |
| 75° | 7,382 lb. | 16.03 |
| 85° | 6,000 lb. | 17.48 |
| 90° | 6,408 lb. | 19.31 |
| 100° | 4,536 lb. | 20.44 |

These results are shown graphically by Figs. 7 and 8.

Besides driving the compressor, the engine had to work both water and brine pumps, and an air pump, and stirring gear in the brine cooler. The water put into the ice moulds was in each experiment at the same temperature as the inlet condensing water.

A test was made of another machine cooling water from 50° F., while the condensing water was gradually increased from 61° to 100°. The results are shown by Fig. 9, the British thermal units abstracted per hour varying from 49,875 with condensing water at 60° F., to 24,867 with condensing water at 100° F.

Another set of tests was made with a small machine cooling brine at various temperatures, with condensing water also varying.

Thus one test was with initial temperature of brine 0°, and condensing water 64°.

The next with brine still at 0°, but water at 81°.

The next with brine still at 0°, but water at 96°, and so on.

Then a similar set of tests was made with brine at 15°, and so on.

The results are shown by Fig. 10, which gives the brine constant and the condensing water varying, and by Fig. 11, giving condensing water constant and brine varying.

These results have been quite independently borne out by Messrs. L. A. Riedinger & Co., of Augsberg, who have had considerable experience in the construction of $CO_2$ machines. Thus from tests over a lengthened period on an ice making machine they obtained the results given below.

With condensing water at 55.4°, and outlet 69°, the ice production was 485 pounds per hour, and with condensing water inlet at 95°, and outlet 97.7°, the ice production was 257 pounds per hour.

The author believes these tropical tests will be viewed with a considerable amount of interest, as they altogether dispel the erroneous idea that the refrigerating effect of $CO_2$ when the temperature of cooling water exceeds 87° F., falls so rapidly that machines under such conditions are practically useless. If any additional evidence were required on this point, it is to be found in the fact that the author's company have no less than 73 $CO_2$ machines permanently working in the tropics, or on board ships constantly passing through the tropics with valuable frozen or chilled cargoes of meat, fruit, etc.

Owing to the very low temperature at which $CO_2$ boils, when the evaporator pressure is much reduced, these machines are very useful in cases where very low temperatures are continuously required.

Thus Messrs. Riedinger have made a machine which, while using condensing water of ordinary temperature, cools continuously the liquid surrounding the evaporator pipes to 67° below zero, Fahr.

The use of $CO_2$ as a refrigerating agent requires also to be considered from the point of view of its effect upon human health and life, for whatever material used, there will be times when an escape occurs into engine room, *e. g.*, when the compressor is opened up for inspection of valves, etc.

From numerous experiments carried out by Dr. Marcet, and described in the Croonian lectures delivered by him this year before the Royal College of Physicians of London, he concludes that if after breathing an atmosphere heavily charged with $CO_2$, a person breathes fresh air, the blood quickly recovers its normal state of aëration, and gives out the whole of the $CO_2$ which it had absorbed. He also quotes

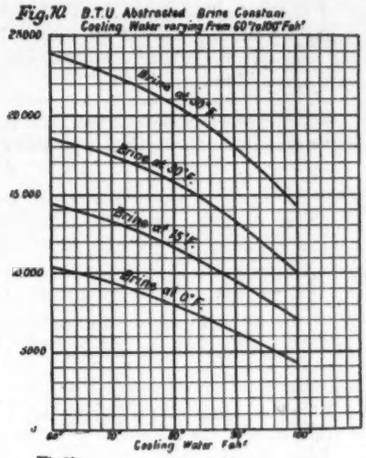


Fig. 10. B.T.U Abstracted. Brine Constant.
Cooling Water varying from 60° to 100° Fah'
Brine at 30° F.
Brine at 20° F.
Brine at 10° F.
Brine at 0° F.
Cooling Water Fah'

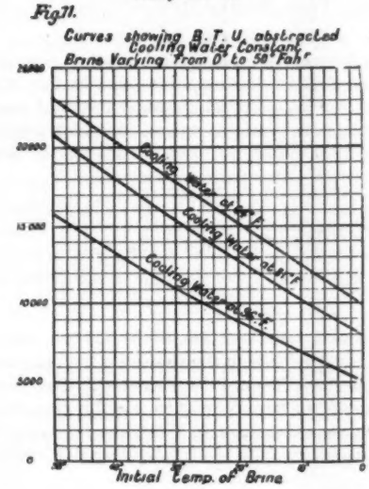
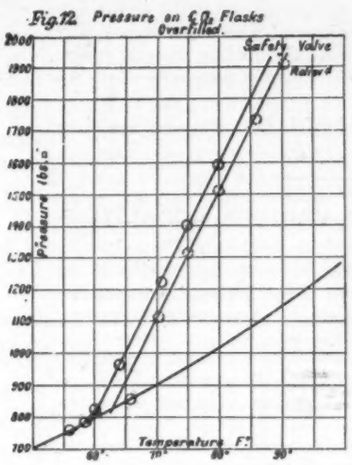
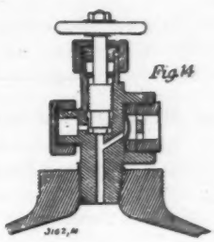
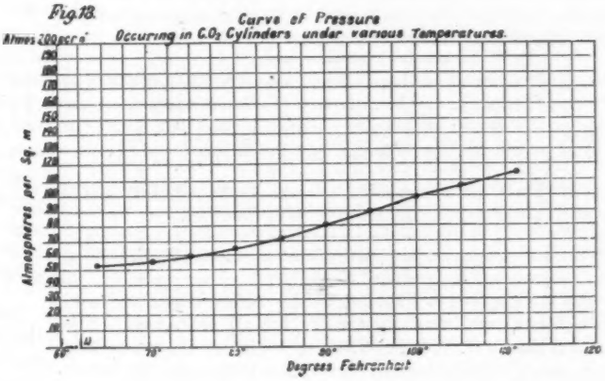


Fig. 11.
Curves showing B. T. U. abstracted
Cooling Water Constant,
Brine Varying from 0° to 50° Fah'
Cooling Water at 90° F.
Cooling Water at 80° F.
Cooling Water at 70° F.
Initial Temp. of Brine




with approval Paul Bert's conclusions that when the atmosphere breathed is so heavily charged with $CO_2$ that death occurs, in such cases death is due to want of oxygen, and that the $CO_2$ is absolutely innocuous.

As to the proportion of this gas in the atmosphere which can be breathed with impunity, some experiments have been made by Dr. von Pettenkofer and Professor Emmerich, who, in company with others, shut themselves up in a small vault of the Institute of Hygiene at Munich with bottles of liquid $CO_2$, the contents sufficing to charge the atmosphere with 17 per cent. of $CO_2$. The vault was lit with candles. The gas was allowed to escape, and after 8 minutes some difficulty in respiration was experienced; after 15 minutes some of the candles went out, and others were burning very faintly. By this time the bottles were empty. A sample of the atmosphere was then taken, and on analysis gave 8.54 per cent. of $CO_2$. One person remained in the vault for 25 minutes, and on leaving he, as well as the rest of the party, in a few minutes entirely got over the effects of the experiment.

Rabbits have for over an hour withstood 34 per cent., and after immersion in an atmosphere containing even 60 per cent. for three-quarters of an hour, they have quickly recovered in the open air.

The fact that a flame is extinguished before the atmosphere becomes too bad to breathe is a safeguard of easy application.

The idea that any $CO_2$ escaping from a machine would, in virtue of its greater weight than the atmosphere, lie on the floor of the room, is erroneous, as, of course, the gas diffuses with the atmosphere, and this action is still further insured by the fact that any appreciable leakage will be at high velocity.

After these remarks it is as well perhaps to observe that although the author has some hundreds of machines at work, he has never heard of a single instance in which there has been the least suspicion of the air in the engine room being overcharged with $CO_2$, and it is a common practice in his workshops, after testing a machine, to blow out the whole contents without the least inconvenience being experienced by his workmen.

*$CO_2$ Flasks.*—Closely allied to the question of the safety of the machines themselves is that of the steel cylinders used for conveying the liquid $CO_2$ for charging the machines. Additional interest is attached to this subject at the present time from the fact that a Department Commission of the Home Office is now considering the whole subject of compressed gas cylinders, and it is probable that in the interest of the public safety some restrictions will be put upon their use.

As far as cylinders for conveying $CO_2$ are concerned, danger can only occur from two causes: (1) insufficient strength to stand the normal strain of the contained gas; or (2) overcharging, and consequent abnormal strain.

1. With regard to the first, Brin's Oxygen Company introduced a method of testing which is now applied to all $CO_2$ flasks supplied by the author's company, whereby, when the proof strain is put on, any permanent set due to straining beyond the elastic limit is at once detected. The cylinder undergoing the test is incased in a closed water jacket, from which rises a long glass tube of small bore with open end. As the cylinder expands under the test pressure the water rises in the glass tube, and when the pressure is relieved the water in the tube returns to its original level unless any permanent set has taken place.

Cylinders for carrying liquid $CO_2$ are tested to 3,000 pounds per square inch.

2. The overcharging of cylinders is always a possible contingency, though it is due to the manufacturers to say that they take every precaution to prevent such, and (so far as the author is aware) hitherto with success. The possibility should, however, be guarded against.

The author made some experiments in order to show what pressures would result with increased temperatures in a cylinder quite filled with liquid $CO_2$, and the results are shown by the curves, Fig. 12.

The lower curve shows the ordinary pressure with varying temperatures for $CO_2$ gas in contact with its liquid. The other two curves show the resulting pressures at varying temperatures in cylinders quite full of liquid $CO_2$. The points where the latter curves cut the former give the temperatures at which the cylinders were filled.

The curve, Fig. 13, shows the pressures obtained at varying temperatures in the case of a cylinder picked out haphazard from a number, just as they were sent in filled from the makers of the carbonic acid.

Now, in order to prevent the possibility of undue pressure occurring, the author introduces into the cylinder valve a safety disc, which,

whether the valve is open or closed, is always exposed to the pressure in the cylinder, and forms, in fact, a weak point which will relieve any excessive pressure. The action of these safety valve discs is shown by the diagram, Fig. 12, for they come into play at the points where the curves cease.

Fig. 14 shows the cylinder valve and safety disc, and a section of an actual valve lies on the table.

## ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

COL. CLEMENT A. WHITE resigned recently from the service of the St. Paul (Minn.) Gas Light Company to accept a responsible position with the Western Gas Construction Company, of Fort Wayne, Ind.

THIS mention of the Western Gas Construction Company brings to mind the fact that it has filed with the proper authority its intention and purpose to increase its capital stock, from $50,000 to $80,000.

THE Receiver of the Athens (Ga.) Gas Company—Mr. Walter A. Mallory—has informed the shareholders of that property that the capacity of the plant will have to be increased if the demands upon it for gas are to be satisfactorily met.

MR. GEO. B. JENKINSON has been elected Vice-President of the Newark (N. J.) Gas Company, vice Mr. Stephen H. Condict, deceased, and the vacancy in the Board of Directors caused by Mr. Condict's death has been filled by the election of Mr. Elisha B. Gaddis.

THE Pittston (Pa.) Gas Company is extending its distributing system, and the new Nanticoke (Pa.) Company is doing likewise.

THE differences between certain parties in interest in the Racine (Wis.) Gas Light Company are to be settled out of court. Very sensibly, the people at odds have agreed to a special master before whom the testimony is to be taken; and very fortunately for all concerned, Judge Seaman named Mr. C. H. Welch, of Athens, Ohio, to the mastership. Although we think it likely that all our readers know who Mr. Welch is, it might not be out-of-bounds to say that he is the clever and energetic Manager of the Athens (O.) Gas and Electric Light Company.

MR. H. M. GLASSBRENNER, the Purchasing Agent of the Jeffersonville (Ind.) Electric Light, Gas, Heating and Coke Company, has been appointed Deputy Auditor of Jeffersonville.

IN our issue for November 4th we reported the arrest of Edward H. Oakes, of Lynn, Mass., charged with defrauding the Lynn (Mass.) Gas Light Company, through the surreptitious use of that Company's product in the premises occupied by him. To complete the story, even though the whole matter is at least a fortnight old, we may say that Oakes was convicted and fined in the sum of $50.

THE Hamilton Auer Light Company, of Hamilton, Canada, has been incorporated. It is capitalized in $50,000, and the promoters are Messrs. W. T. Andrews, W. L. Phelps, W. F. Walker, M. P. Layland and S. G. Treble, all of Hamilton.

ACCORDING to advices from Newark, N. J., dated the 14th inst., the East Newark Gas Light Company has been reorganized, with the following officers in charge: Directors, E. Luther Joy, Andrew Kirkpatrick, George E. Halsey, Charles A. Lighthipe, Henry C. Kelsey and W. R. Davis; President, E. L. Joy; Vice-President, Geo. E. Halsey; Secretary and Treasurer, James P. Dusenberry.

THE attorneys for the Portsmouth (Va.) Gas Company have entered suit on behalf of that corporation against Messrs. Sandford, Brooks & Bonsil, sewer contractors, for the sum of $1,580. The cause of action is damage to the Company's mains occasioned by the negligence of the named contractors while constructing sewers for the account of the city.

THE reorganization of the Warsaw (N. Y.) Gas and Electric Company resulted in the choice of the following Directors: E. O. McNair, M. J. Rowe, L. H. Humphrey, S. D. Lewis, G. C. Otis, E. H. Morris and E. M. Bartlett. Mr. L. H. Tozier was appointed Superintendent in place of Mr. E. E. Rowe.

THE proprietors of the Norwalk (O.) Gas Light Company have settled the case brought against them by Kate Valentine, who sued for damages in the sum of $5,000 for the death of her daughter. The child, while playing in the street, took hold of an electric light wire, which had fallen on the roadway, and was shocked to death. It is said that the compromise sum agreed upon was $2,000.

WORK on main laying is underway at Tampa, Fla., and the new gas plant there will be completed well within the time stipulated in the contract.

WE regret to announce the death, at Ann Arbor, Mich., on the 13th inst., of Mr. James Clements, President of the Bay City (Mich.) Gas Light Company. Deceased, who was in his 70th year, was born in England, but came to the United States in early youth, first settling in New York city. About 1852 he became actively engaged in the gas business, notable gas constructions in which he figured being the plants at Lansing, Bay City and Port Huron, Mich., Leavenworth, Kas., and St. Joseph, Mo. He built the first street railway in Bay City, and was also concerned in many other solid enterprises of that place. He had been a member of the Michigan Legislature, and at the time of his death was an honored vestryman of the Episcopal Church of St. Andrews, in Ann Arbor. Four children (two sons and two daughters) survive him.

THE Philadelphia *Herald* says that plans have just been completed, under the supervision of Chief Park and his subordinates, of the Philadelphia Gas Bureau, for extensive additions to the 25th ward station (Port Richmond) of the municipal gas works. A coal storage shed, 108 feet by 335 feet, to be built mainly of brick, is one of the betterments arranged for.

MR. PERRY HOBBS has been succeeded by Mr. Charles Snyder in the position of City Gas Inspector for Cleveland, O. The understanding is that Mr. Snyder, who is a graduate of the Case School of Applied Science, Cleveland, will devote all of his time to the duties of the inspectorship.

THE Commissioners of Lamps and Gas, of New York, have fixed on December 2d as the date for opening the proposals for the public lighting of this city for one year from December 31st. The Commission also instructed Corporation Counsel Scott to examine the contracts for street lighting in the annexed district, in Westchester county. The city maintains, in round numbers, 2,751 electric lights and 25,000 gas lamps.

SOME time ago the Common Council, of Hartford, Conn., passed a resolution appointing a special committee to inquire into the advisability of establishing a gas works to be maintained and operated on city account. In due time the resolution came before the Mayor (Mr. Leverett Brainard), and he returned the same to the Council with his disapproval. The following memoranda accompanied the veto:

"To the Court of Common Council, Hartford, Conn.: I return, without approval, the resolution continuing the Committee on Gas, which instructs said committee 'to add such business men as they may deem of advantage to ascertain and report the probable cost of establishing and operating a gas plant.' A report, based on reliable data, would require the services of men skilled not only in the cost of constructing, but of operating as well, for which services the city would be in honor bound to give reasonable remuneration, and such report would also require much of the committee's time. In my opinion the exigencies of the situation are not such as to justify or call for the time and expense. The present Gas Company has pipe laid throughout the city, and nothing short of extreme necessity would warrant the annoyance to our citizens of having the streets dug up for the laying of new pipe. If, as the committee report, the present Company is not willing to comply with reasonable requirements, and there is no power to compel it to, an appeal should be made to the Legislature for an enactment applicable to the situation. If the city decides that it will undertake the supply of gas, in the interest of the city and of fair and honorable dealing, negotiations should be entered into for the purchase of the present works, thereby avoiding many unpleasant complications. The Legislature, recognizing the justice of such a course, at its 1893 session enacted a law prescribing that any city desiring to construct a gas plant where one already exists, should first attempt negotiations with the existing Company for its purchase; the Act also prescribes the manuer in which such negotiations should be made, as well as the steps to be taken for the construction of new works. If the city shall decide to manufacture and supply gas to its citizens, it seems desirable that preliminary action should proceed in accordance with the requirements of law."

THE Council, in considering the veto, discussed the same in desultory fashion, but at some length, and the result was that the resolutions were

passed over the Mayor's objections. The main spirit of the discussion was that as there was nothing in the resolutions committing the Committee to building a gas works, an inquiry on the lines proposed could not possibly result in harm.

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ACCORDING to the report of Inspector Gilbert, for the month of October, the illuminating power of the gas supplied in Omaha, Neb., during that month averaged 25 candles.

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AT a special meeting of the Board of Directors of the Chester (Pa.) Gas Company, called to take suitable action over the death of Mr. John O. Deshong, the following resolutions were adopted: "The Board of Directors of the Chester Gas Company, sensible of the most profound regret for the death of their fellow-member, John O. Deshong, Jr., deem it fitting that they should give public expression to their sorrow and testimonial in appreciation of his worth. The loss of so valuable a man has inflicted a severe blow upon the community, and especially will his absence from the management of the affairs of this Company be deeply felt. He has been a Director continuously for over 30 years, and for a long time he has served the Company in the capacity of one of its executive officers. By his wise counsel, penetrating forethought, and sound judgment, as well as by his affable, courteous and gentlemanly manners, he has rendered valuable and attractive services to advance the interests of this Company, and has at all times been one of its leading spirits. We, therefore,

"*Resolve*, That by his death this Company has sustained great loss, and we join with the public in rendering a testimonial to his affectionate, amiable and genial qualities, which endeared him to those who were brought into contact with him, and also to the wise counsel and reliable judgment which made him valuable as an adviser and counselor to all who sought his aid in those respects.

"It is directed that this resolution be spread at large upon the minutes and a copy forwarded to his family by the officers of this Company.

"J. H. ROOP, Sec. JONATHAN R. JOHNSON, Pres."

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THE Syracuse (N. Y.) *Courier*, dated the 18th inst., had this to say: "It was rumored Saturday that the new Gas Company, of New York and Philadelphia capitalists, had secured finally complete control of the local gas plant, by transfer of the necessary stock for control. Mr. A. A. Howlett, President of the old Company, said last night: 'Mr. Pruyn, representing men of money and reputation, secured controlling interest and practically whole interest of the Gas Company in October. They have asked us to continue in control for some time yet. All the stock has not been turned over because some is held by people at such a distance that it could not well be. One thousand shares are expected from Texas to-morrow. The present Company has endeavored to give Syracuse good service. Gas has been delivered at a price below that asked in very many cities. In return the Company has been treated abominably by the Common Council. The people in the new Company are all men of means and ability, and under their management Syracuse will not suffer. There will not be a minority of people of the old Company to bother them in any way. What stock has not been turned in already will be turned in within the 40 days set for final settlement upon the terms agreed upon. While we shall remain in charge until the new Company is ready to fill our places, the new Company will be practically in control before the end of November.'".

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THE Marysville (Cal.) Gas Company, through its attorney (Mr. M. E. Sanborn), has filed papers announcing its intention of hereafter doing business under the title of the Marysville Gas and Electric Company. The Company is capitalized in $500,000, of which $100,000 is paid up. The main interests in the Company are those represented by Messrs. D. E. Knight and A. C. Bingham.

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THE Salamanca (N. Y.) Natural Gas Company has notified its consumers that hereafter the net rate per 1,000 cubic feet will be 26 cents instead of 24 cents.

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THE Gloucester (Mass.) Gas Company is extending its main system.

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THE proprietors of the Ilion and Mohawk (N. Y.) Gas Light Company have determined to construct a new storage holder.

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THE Citizens Gas Company, which proposes to supply "fuel gas" to the residents of Bridgeport, Conn., under the guiding genius of Mr. Burdett Loomis, claims that it will be in readiness to make gas before the winter is over. Perhaps! The plant proper is located on a plot on Howard avenue, to the north of the old factories of the Springfield Emery Wheel Company.

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THE Massachusetts Board of Gas and Electric Light Commissioners has had plenty to do this fall. Some of the things that occupied the Board are appended: The Board approved an issue of $12,000 stock and $42,000 bonds by the Milton Light and Power Company. This makes the capital stock and bond issues equal in amount, at $42,000 each. Of the new bond issue $30,000 will retire an equal amount of an old issue. The balance of new stock and bonds goes to plant extensions. The Dorchester Gas Light Company is before the Board for an increase in its capital of $150,000, which sum is needed to pay existing debts and to provide for extensions. The Chicopee Gas Company has applied for permission to issue $40,000 of stock. The gas works at Chicopee have hitherto been operated by private rather than incorporate management, but it is now proposed to take them under a stock company proposition.

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AT the annual meeting of the Elizabethtown (N. J.) Gas Company the Directors chosen were: John Kean, J. H. Kean, H. F. Kean, A. L. Kean and Jas. McGuire.

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ON the 16th inst. papers incorporating the Chemung Gas and Electric Light Company, of Elmira, N. Y., were filed in Albany. The Company is capitalized in $200,000, and the Directors are: Messrs. C. G. S. Thomas, Arthur S. Pinkham, Paul C. Safford, Frank McKelvey, John Doyle, George T. Carhart and Albert E. Ettinger. The incorporators are all of this city.

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UNLESS all signs fail an agreement for harmony of interest, at least—indeed, we are warranted in saying everything points to unity of interest—has been reached between the proprietors of the San Francisco Gas Light Company and the Edison Electric Light Company, of San Francisco. The Edison Company is capitalized in $2,020,000 and bonded in $500,000, and the Gas Company's paid up capital is $8,400,000.

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THE city of Memphis, Tenn., has brought suit against the Equitable Gas Light Company, of Memphis, for a fine of $50,000, which is the penalty named in the city ordinance, under which the Equitable Company operates, in case the Company ever consolidated its interests with those of the New Memphis Gas Light Company. The city claims that such consolidation has been perfected, but it will be hard set to prove it. Meanwhile we may say that both Companies will contest to the end the validity of the ordinance declaring that the price of gas in Memphis hereafter shall not exceed $1.50 per 1,000 cubic feet.

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THE Windsor (Can.) Gas Company has applied to the Court of Revision against the assessment on its property. It alleges that the assessments on the lands and plant are too high; that the mains which are assessed this year for the first time are not assessable, and that discrimination is shown in favor of the telephone and telegraph companies, they being assessed only on incomes. The Court deemed it advisable to have this appeal decided by a higher authority and confirmed the assessment. The Company may now appeal to the County Judge.

## The Preparation of Graphite.

The London *Journal* "notes" that it is not many years since the form of carbon known as graphite was only to be obtained from the incrustation upon the inside surfaces of gas retorts; and the term "gas retort carbon" is still occasionally employed by writers who mean to refer to what is really graphitic carbon. Numerous experiments—in particular those of M. Moissan—with the electric furnace, have now proved that graphite is the most stable form of carbon at high temperatures, and is in fact the form to which all other descriptions of carbon can be brought at a proper temperature. The best way of making graphite is by means of the electric furnace; but this has hitherto been also the most expensive process. Messrs. Girard and Street, Engineers to a French manufacturing society, claim to have successfully overcome this difficulty of cost, and to be able to transform powdered carbonaceous material into graphite electrically, at an expenditure of current not too great to prejudice the commercial utility of the process. Their apparatus consists of an arrangement of refractory blocks, through which passes a rod or tube of the material to be converted into graphite, and a set of carbons for striking the electric arc across this tube or rod. An equable distribution of the heat is effected by causing a magnet to rotate the electric arc, according to a well known principle. A stream of hydrocarbon gas can at the same time be passed through the furnace, which thus reproduces—although at a much higher temperature, and through a shorter period of time—the conditions under which graphite is formed in a gas retort. The new process, however, can hardly be a cheap one where the electric energy is not produced by water power.

THE AMERICAN GAS LIGHT JOURNAL

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MONDAY, NOVEMBER 25, 1895.

## Steam Separators.

The *Safety Valve* says that the tendency of advanced engineering seems to be towards changing the location of the steam pump. Formerly almost every boiler turned out was fitted with a pump of greater or less capacity. The object of this mechanism was to obtain dry steam for the engine. A few years since eminent authority declared itself against the use of the steam pump, and for a long time it has been the private opinion of the writer that "the best place for a steam pump is on somebody else's boiler." Up to date practice seems to be in the direction of using the old pump, but its position is considerably changed. Instead of being attached to the boiler, it is now connected direct to the engine. The piping, instead of being between pump and engine, is now placed between boiler and pump. In other words, the pump is located at the engine, and forms a sort of separator for collecting whatever may come over through the steam pipe.

The boiler pump, therefore, has degenerated (or progressed) into a separator for catching the entrained water carried off by the steam. The present separator practice is merely an exemplification of the old fashioned catch basin, which used to be applied at the engine for taking care of whatever water came along through the steam pipe. A very close approximation to the best separators in the market can be made by attaching a T to the engine in place of the usual elbow, where the pipe leaves the vertical to run in a horizontal direction towards the steam chest. To the lower end of the T a piece of pipe of convenient length is attached. The theory is that steam coming down through the pipe will drop most of its entrained water as it makes the turn to pass at right angles towards the engine. The water shoots up the horizontal pipe while the steam passes in. This action can be made much more certain if a special T is used instead of an ordinary one. The pipe going down should terminate in a sort of nozzle instead of in the usual curved surfaces found in a T. When the rudimentary nozzle is used the water seems to be carried vertically downward to a much greater extent than when some of it can creep down the walls of the casting. If the T be made one or two sizes larger than the rest of the pipe, there will be room inside for a nozzle equal in diameter to the body of the main pipe. The larger T also causes the velocity of the flowing steam to decrease, giving the water a much greater chance to separate. With the addition of a water line glass to the lower end of a drop pipe mentioned above, also with a drop pipe fitted on, a very close approximation is obtained to some of the best separators in use on high grade plants.

## Air Burning in Gas.

One of the most interesting phenomena of daily life is the combustion of gas, a simple combination of two elements, hydrogen and carbon, which we lead into our dwellings in pipes and allow to escape through a small orifice for the purposes of illumination. The chemical reaction which takes place at a comparatively high temperature, produces a series of wave motions, which convey to our brain through the medium of the mechanism of our eyes the sensation of sight. We are accustomed to believe because the conditions have always been that this gas will burn only in atmospheric air, and this to a certain extent is true. It burns because of the oxygen in the air, the nitrogen playing an unimportant part. Were we to burn the gas in an atmosphere of pure oxygen the combustion would be more rapid, the light more intense. By combining various gases in combination with other materials, such as lime, or chalk, or manganese, or iron, or pure carbon, in fact, almost any of the so-called elements, we are still able to produce intense light rays; but it may be new to some of our readers at least, that under certain conditions air can be made to burn in precisely the same manner as gas can at present. In other words, supposing we reverse the conditions exactly and produce an atmosphere of pure gas and lay down our air in pipes in exactly the same method in which our gas is laid at present, and deliver it through a burner, we would then burn the air, or at least produce flame the exact equivalent of that which we now produce by burning gas in air; in fact, we could burn air in gas. The experiment is a simple one and easily tried by anyone of a turn of mind so disposed. Take a small receiver—for instance, a large glass lamp chimney. Cover one end of it with a bit of sheet rubber, or still better, with a mass of plaster of paris, and lead into it a little tube of glass or metal for the admission of air, with another one also which would maintain a constant supply of gas. Cover the top with a sheet of metal for a few minutes and turn on the gas until the receiver is entirely filled. Slide off the cover and replace it quickly, so as not to allow the gas to escape, with one in which a small hole has been bored—a sheet of asbestos will do very well. The current of gas then will keep the receiver full without the admixture of any atmospheric air, except such as is introduced through the little tube in the center. Apply a match at the bottom; the flame will jump through the receiver, lighting both the air jet inside and the gas jet on top. If the experiment is properly conducted there will be no explosion whatever. The result will be a jet of air burning in the atmosphere of gas, and a jet of gas burning from the little hole at the top, in air. The experiment is a most interesting one and is well worth trying.

## The Market for Gas Securities.

The general share market was weak and uneven since last time of writing, the speculators for short account having all the best of the argument. Pessimistic opinions respecting the future had the call in the speech of brokers and money lenders, and the exports of gold were always quoted to show that nothing but disaster was ahead for those who refused to part with their shares at the ruling values of the day. So far as city gas shares were concerned, however, the pessimists seem to have had their labor for their pains, in that if they expected to adversely influence prices for gas securities, so as to increase their holdings thereof, they failed.

The dealings in Consolidated were on a scale somewhat smaller than those reported in it for some weeks back, but the stock held fairly well. It came in to-day (Friday) at 148¼, which was the bid price. The uncertainty about the dividend for the past quarter continues, but as the time for its declaration is close at hand, the suspense will soon be over. Whether the dividend is increased or not, dealers in the stock should distinctly remember that the Company can easily pay 10 per cent., and still keep on adding comfortably to its surplus.

Other city gas shares are steady to strong, notably Mutual, which is bid for at 198, with no sign of any stock coming out. Equitable is steady at 200 bid. Some signs of absorption of New York and East River common are again in evidence, and our belief is that it offers at current figures a fair chance for a good speculative turn. Indeed, we would not be a bit surprised if it mounted permanently to 38 to 40. It is rumored that an arrangement could be made between the East River concern and the new Brooklyn Union Company for a partial supply (perhaps one-half) of gas to the latter by the former, which it is said would enable the closing down of all save one of the latter's manufacturing plants, thus releasing for sale much valuable water front property. We only give this as a rumor, for of our knowledge thereof we know not. Standard preferred is steady, as is also the common.

The process of rearrangement in Brooklyn is going steadily on, the Brooklyn Union Company being in full control. The stock of the new concern is bid for at 84, and the bonds are quoted at 107⅜ to 107¾. The quotation for the stock looks to us to be on the high side. Some talk is being indulged in of an opposition company, on a bona fide basis, and the names of several thrifty Brooklyn politicians are mentioned in connection therewith. Meanwhile Mr. J. Edward Addicks is smiling contentedly over the personal outcome to him of his Brooklyn venture.

In out-of-town shares, the feature is continued weakness in Chicago, which sold to-day at 63. There is no good reason for this depression, and the shares are cheap at anything under 65, for the complete legal rehabilitation of the Company is assured. The decline in Baltimore Consolidated continues, and the reason therefor is that the Legislature and the Governor-elect are said to believe the Baltimore gas rates are too high. Bay State is a shade higher than it was a week ago, and Lacledes, particularly the preferred, are also stronger. The Company pays, on December 16th, a semi-annual dividend of 2½ per cent., also an extra dividend of 1 per cent. on the preferred stock. Other dividends are: American Gas Company, $3 per share, payable on December 2; Welsbach Commercial Company, 2 per cent., payable December 10.

## Gas Stocks.

**Quotations by Cochran & Close, Brokers and Dealers in Gas Stocks.**

35 Wall St., New York City.

November 25.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

| *N. Y. City Companies.* | *Capital.* | *Par.* | *Bid.* | *Asked.* |
|---|---|---|---|---|
| Consolidated | $35,430,000 | 100 | 147½ | 148¼ |
| Central | 500,000 | 50 | 150 | .. |
| " Scrip | 220,000 | .. | 100 | .. |
| Equitable | 4,000,000 | 100 | 199 | 202 |
| Bonds, 6's | 1,000,000 | 1,000 | 106 | .. |
| " 1st Con. 5's | 2,300,000 | 1,000 | 114 | — |
| Metropolitan Bonds | 658,000 | .. | 108 | 112 |
| Mutual | 3,500,000 | 100 | 198 | .. |
| " Bonds | 1,500,000 | 1,000 | 100 | 102 |
| Municipal Bonds | 750,000 | .. | .. | . |
| Northern | 150,000 | 50 | 79 | 80½ |
| " Bonds | 150,000 | 1,000 | .. | 98 |
| New York and East River | 5,000,000 | 100 | 83¾ | 84 |
| Preferred | 2,000,000 | 100 | 68¾ | 69¼ |
| Bonds 1st 5's | 3,500,000 | 1,000 | 100¼ | 101⅛ |
| " 1st Con. 5's | 1,500,000 | .. | 86¼ | 87½ |
| Richmond Co., S. I. | 348,650 | 50 | 50 | .. |
| " Bonds | 100,000 | 1,000 | .. | .. |
| Standard | 5,000,000 | 100 | 71½ | 73½ |
| Preferred | 5,000,000 | 100 | 107 | .. |
| Bonds, 1st Mortgage, 5's | 1,500,000 | 1,000 | 100 | .. |
| Yonkers | 299,650 | 50 | 112 | .. |
| *Gas Co's of Brooklyn.* | | | | |
| Brooklyn | 2,000,000 | 25 | 140 | .. |
| Citizens | 1,200,000 | 20 | 70 | .. |
| " S. F. Bonds | 320,000 | 1,000 | .. | 101 |
| Equity | 2,000,000 | 10 | .. | .. |
| " Bonds | 1,000,000 | .. | .. | .. |
| Fulton-Municipal | 3,000,000 | 100 | 220 | .. |
| " Bonds | 300,000 | .. | 103 | .. |
| Peoples | 1,000,000 | 10 | 100 | . |
| " Bonds, 7's | 368,000 | .. | 100 | .. |
| " " 6's | 94,000 | .. | 98 | 100 |
| Metropolitan | 870,000 | 100 | 200 | .. |
| " Bonds, 5's | 70,000 | .. | .. | .. |
| Nassau | 1,000,000 | 25 | 310 | .. |
| " Ctfs. | 700,000 | 1,000 | 99 | 100 |
| Williamsburgh | 1,000,000 | 50 | 310 | .. |
| " Bonds | 1,000,000 | .. | 107 | 110 |
| *Out-of-Town Companies.* | | | | |
| Bay State | 5,000,000 | 50 | 22 | 22½ |
| " Income Bonds | 2,000,000 | 1,000 | 27 | 30 |
| Boston United Gas Co.— | | | | |
| 1st Series S. F. Trust | 7,000,000 | 1,000 | 81 | 82 |
| 2d " " " | 3,000,000 | 1,000 | 56½ | 57 |
| Buffalo Mutual | 750,000 | 100 | 125 | .. |
| " Bonds | 200,000 | 1,000 | 95 | 100 |
| Central, San Francisco | 2,000,000 | .. | 95 | .. |
| Chicago Gas Co. | 25,000,000 | 100 | 63 | 63¼ |
| Chicago Gas Lt. & Coke Co. Guaranteed Gold Bonds. | 7,650,000 | 1,000 | 94 | 94¼ |
| Columbus | 1,000,000 | .. | 66½ | 67 |
| 1st Mortgage | 1,085,000 | .. | 94 | 95 |
| Consumers, Jersey City | 2,000,000 | 100 | 87 | 91 |
| " Bonds | 600,000 | 1,000 | 100 | 108 |
| Cincinnati G. & C. Co. | 7,000,000 | 100 | 203¾ | 204 |
| Consumers, Toronto | 1,600,000 | 50 | 184½ | 187 |
| Capital, Sacramento | 500,000 | 50 | .. | 41 |
| Bonds (6's) | 150,000 | .. | .. | .. |
| Consolidated, Baltimore | 11,000,000 | 100 | 60 | 63 |
| Mortgage, 6's | 3,600,000 | .. | 107 | 107½ |
| Chesapeake, 1st 6's | 1,000,000 | .. | .. | .. |
| Equitable, 1st 6's | 910,000 | .. | .. | .. |
| Consolidated, 1st 5's | 1,490,000 | .. | .. | .. |
| Detroit | 4,000,000 | .. | 29½ | 30¼ |
| " Con. Bonds | 4,512,000 | .. | .. | 70 |
| Equitable Gas & Fuel Co., Chicago, Bonds | 2,000,000 | 1,000 | .. | 101 |
| Fort Wayne | 2,000,000 | .. | 77 | 80 |
| " Bonds | 2,000,000 | .. | 88½ | 90 |
| Hartford | 750,000 | 25 | 130 | 135 |
| Indianapolis | 2,000,000 | .. | 142 | .. |
| " Bonds, 6's | 2,650,000 | .. | 103¾ | 105 |
| Jersey City | 750,000 | 20 | 180 | .. |
| Lafayette Gas Co., Ind. | 1,000,000 | 100 | 83 | 85 |
| Bonds | 1,000,000 | 1,000 | 85 | 87 |
| Louisville | 2,570,000 | 50 | .. | 130 |
| Laclede, St. Louis | 7,500,000 | 100 | 23¾ | 23 |
| Preferred | 2,500,000 | 100 | 86 | 88 |
| Bonds | 9,034,400 | 1,000 | 96¾ | 97 |
| Little Falls, N. Y. | 50,000 | 100 | .. | 100 |
| Bonds | 25,000 | .. | .. | 100 |
| Montreal, Canada | 2,000,000 | 100 | 200 | .. |
| Newark, N. J., Gas Co. | 1,000,000 | .. | 75 | . |
| Bonds, 6's | 4,000,000 | .. | 120 | .. |
| New Haven | 1,000,000 | 25 | 225 | .. |
| Oakland, Cal. | 2,000,000 | .. | 46½ | .. |
| " Bonds | 750,000 | .. | .. | .. |
| Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage | 2,100,000 | 1,000 | .. | 108 |
| 2d " " | 2,500,000 | 1,000 | 104 | 105 |
| Peoples, Jersey City | 500,000 | 50 | .. | 175 |
| Paterson, N. J. | ..... | 25 | 99 | 102 |
| Rochester Gas & Elec. Co. | 2,150,000 | 50 | .. | .. |
| Preferred | 2,150,000 | 50 | 88 | .. |
| Consolidated 5's | 2,000,000 | .. | 87½ | 90 |
| San Francisco, Cal. | 10,000,000 | 100 | 70½ | 71 |
| St. Paul Gas Light Co. | 1,500,000 | 100 | 68½ | 70 |
| 1st Mortgage, 6's | 650,000 | .. | 88 | 90 |
| Extension, 6's | 600,000 | .. | .. | .. |
| General Mortgage, 5's | 2,400,000 | .. | 88 | 90 |
| Syracuse, N. Y. | 500,000 | 25 | .. | .. |
| Washington, D. C. | 2,000,000 | 20 | 250 | .. |
| Western, Milwaukee | 4,000,000 | 100 | 68½ | 70 |
| Bonds, 5's | 3,556,000 | .. | 93 | 94 |
| Wilmington, Del. | 500,000 | 50 | 188 | 190 |

## Advertisers' Index.


**GAS ENGINEERS.**

| | Page |
|---|---|
| Jos. R. Thomas, New York City | 884 |
| Wm. Henry White, New York City | 883 |
| Fred. Bredel, Milwaukee, Wis. | 879 |
| H. C. Slaney, Brooklyn, N. Y. | 883 |
| Geo. R. Rowland, New York City | 883 |
| The Western Gas Construction Co., Fort Wayne, Ind. | 874 |
| Humphreys & Glasgow, New York City | 870 |
| T. G. Lansden, St. Louis, Mo. | 883 |

**PROCESSES.**

| | |
|---|---|
| Bartlett, Hayward & Co., Baltimore, Md. | 881 |
| United Gas Improvement Co., Phila., Pa. | 873 |
| Burdett Loomis, Hartford, Conn. | 882 |
| National Gas and Water Co., Chicago, Ills. | 875 |
| Economical Gas Apparatus Construct'n Co., Toronto, Ont | 887 |
| The Western Gas Construction Co., Fort Wayne, Ind. | 874 |

**GAS WORKS APPARATUS AND CONSTRUCTION.**

| | |
|---|---|
| James R. Floyd & Sons, New York City | 884 |
| Continental Iron Works, Brooklyn, N. Y. | 882 |
| Deily & Fowler, Phila., Pa. | 884 |
| Kerr Murray Mfg. Co., Fort Wayne, Ind. | 880 |
| Stacey Mfg. Co., Cincinnati, Ohio. | 883 |
| Bartlett, Hayward & Co., Baltimore, Md. | 881 |
| Davis and Farnum Mfg. Co., Waltham, Mass. | 880 |
| R. D. Wood & Co., Phila., Pa. | 882 |
| Isbell-Porter Company, New York City | 882 |
| Fred. Bredel, Milwaukee, Wis. | 879 |
| United Gas Improvement Co., Phila., Pa. | 873 |
| Berlin Iron Bridge Co., East Berlin, Conn. | 870 |
| National Gas and Water Co., Chicago, Ills. | 875 |
| Economical Gas Apparatus Construct'n Co., Toronto, Ont. | 887 |
| The Western Gas Construction Co., Fort Wayne, Ind. | 874 |
| Humphreys & Glasgow, New York City | 870 |
| Gas Engineering Co., Pittsburgh, Pa. | 880 |

**SCRUBBERS AND CONDENSERS.**

| | |
|---|---|
| G. Shepard Page's Sons, New York City | 883 |
| R. D. Wood & Co., Phila., Pa. | 882 |
| James R. Floyd & Sons, New York City | 884 |
| Continental Iron Works, Brooklyn, N. Y. | 882 |
| Gas Engineering Co., Pittsburgh, Pa. | 880 |

**REGENERATIVE FURNACES.**

| | |
|---|---|
| Bartlett, Hayward & Co., Baltimore, Md. | 881 |
| Fred. Bredel, Milwaukee, Wis. | 879 |
| J. H. Gautier & Co., Jersey City, N. J. | 879 |
| Parker-Russell Mining and Mfg. Co., St. Louis, Mo. | 874 |
| Adam Weber, New York City | 874 |

**TAR AND CARBONIC ACID EXTRACTOR.**

| | |
|---|---|
| G. Shepard Page's Sons, New York City | 883 |

**AMMONIA CONCENTRATORS.**

| | |
|---|---|
| Michigan Ammonia Works, Detroit, Mich. | 864 |
| G. Shepard Page's Sons, New York City | 883 |
| Gas Engineering Co., Pittsburgh, Pa. | 880 |

**GAS METERS.**

| | |
|---|---|
| John J. Griffin & Co., Phila., Pa. | 888 |
| American Meter Co., New York and Philadelphia | 887 |
| The Goodwin Meter Co., Phila., Pa. | 836 |
| Helme & McIlhenny, Phila., Pa. | 887 |
| D. McDonald & Co., Albany, N. Y. | 887 |
| Nathaniel Tufts, Boston, Mass. | 886 |
| Maryland Meter and Mfg. Co. Baltimore, Md. | 886 |
| Metric Metal Co., Erie, Pa. | 885 |
| Keystone Meter Co., Royersford, Pa. | 886 |
| The Hillen Meter Co., Brooklyn, N. Y. | 887 |

**GAS AND WATER PIPES.**

| | |
|---|---|
| Ohio Pipe Co., Columbus, Ohio | 885 |
| M. J. Drummond, New York City | 835 |
| R. D. Wood & Co., Phila., Pa. | 882 |
| Warren Foundry and Machine Co., New York City | 885 |
| Donaldson Iron Co., Emaus, Pa. | 835 |
| Addyston Pipe and Steel Co., Cincinnati, O. | 884 |

**GAS BAGS.**

| | |
|---|---|
| Peerless Rubber Mfg. Co., New York City | 885 |

**STEAM BLOWER FOR BURNING BREEZE.**

| | |
|---|---|
| H. E. Parson, New York City | 879 |

**GAS COALS.**

| | |
|---|---|
| Penn Gas Coal Co., Phila., Pa. | 877 |
| Perkins & Co., New York City | 876 |
| Despard Gas Coal Co., Baltimore, Md. | 877 |
| Westmoreland Coal Co., Phila., Pa. | 877 |
| Shaner Coal Co., Philadelphia, Pa. | 885 |
| Berwind-White Coal Mining Co., New York and Phila. | 876 |
| Henry C. Scheel, New York City | 877 |

**CANNEL COALS.**

| | |
|---|---|
| Perkins & Co., New York City | 876 |
| Henry C. Scheel, New York City | 877 |

**GAS ENRICHERS.**

| | |
|---|---|
| Standard Oil Co., New York City | 877 |
| The Sun Oil Co., Pittsburgh, Pa. | 877 |
| W. H. Townsend, New York City | 877 |

**COKE CRUSHER.**

| | |
|---|---|
| C. M. Keller, Columbus, Ind. | 877 |

**CONVEYING MACHINERY.**

| | |
|---|---|
| C. W. Hunt Company, N. Y. City | 885 |

**GAS GAUGES.**

| | |
|---|---|
| The Bristol Co., Waterbury, Conn. | 884 |

**GAS GOVERNORS.**

| | |
|---|---|
| Connelly Iron Sponge and Governor Co., New York City. | 875 |
| Isbell-Porter Co., New York City | 882 |

**SELF-SEALING MOUTHPIECE DOORS.**

| | |
|---|---|
| Isbell-Porter Company, New York City | 882 |
| Continental Iron Works, Brooklyn, N. Y. | 882 |
| G. Shepard Page's Sons, New York City | 883 |

**RETORTS AND FIREBRICK.**

| | |
|---|---|
| J. H. Gautier & Co., Jersey City, N. J. | 878 |
| B. Kreischer & Sons, New York City | 878 |
| Adam Weber, New York City | 878 |
| Laclede Firebrick Mfg. Co., St. Louis, Mo. | 878 |
| Cyrus Borgner, Phila., Pa. | 878 |
| James Gardner, Jr., Pittsburgh, Pa. | 878 |
| Henry Maurer & Son, New York City | 878 |
| Baltimore Retort and Firebrick Co., Baltimore, Md. | 878 |
| Parker-Russell Mining and Mfg. Co., St. Louis, Mo. | 878 |
| Brooklyn Firebrick Works, Brooklyn, N. Y. | 878 |
| F. Behrend, New York City | 865 |

**CEMENTS.**

| | |
|---|---|
| C. L. Gerould & Co., Mount Vernon, N. Y. | 878 |
| F. Behrend, New York City | 865 |

**INCANDESCENT GAS LAMPS.**

| | |
|---|---|
| Welsbach Light Co., Gloucester, N. J. | 867 |

**MICA GOODS.**

| | |
|---|---|
| The Mica Mfg. Co., New York City | 865 |

**BURNERS.**

| | |
|---|---|
| C. A. Gefrorer, Phila., Pa. | 882 |
| George Bray & Co., Leeds, England | 868 |
| Theo. Clough, Dobbs Ferry, N. Y. | 864 |

**LAVA GAS TIPS.**

| | |
|---|---|
| D. M. Steward Mfg. Co., Chattanooga, Tenn. | 865 |

**GAS TUBING.**

| | |
|---|---|
| New York Gas Tubing Co., New York City. | 865 |

**STREET LAMPS.**

| | |
|---|---|
| Bartlett Lamp Mfg. Co., New York City. | 879 |

**PURIFYING MATERIALS.**

| | |
|---|---|
| Connelly Iron Sponge and Governor Co., New York City | 875 |
| Greenpoint Chemical Works, Brooklyn, N. Y. | 875 |
| Henry W. Douglas, Ann Arbor, Mich. | 875 |

**EXHAUSTERS.**

| | |
|---|---|
| The P. H. & F. M. Roots Co., Connersville, Ind. | 872 |
| Isbell-Porter Company, New York City | 882 |
| Connelly Iron Sponge and Governor Co., New York City | 875 |

**VALVES.**

Ludlow Valve Manufacturing Co., Troy, N.Y..... 874
Chapman Valve Manufacturing Co., Boston, Mass..... 874
R. D. Wood & Co., Phila., Pa..... 882
Continental Iron Works, Brooklyn, N. Y..... 882
The P. H. & F. M. Roots Co., Connersville, Ind..... 872
Isbell-Porter Co., New York City..... 882
The Western Gas Construction Co., Fort Wayne, Ind.... 874

**ELECTRICAL APPARATUS.**

Wm. Henry White, New York City..... 883

**GAS ENGINES.**

Otto Gas Engine Works, Phila., Pa..... 888
The American Gas Engine Co., Phila., Pa..... 866

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The Hazelton Boiler Company, New York City..... 884
W. G. & G. Greenfield, East Newark, N. J..... 884

**PURIFIER SCREENS.**

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The Goodwin Meter Co., Phila., Pa..... 886
George M. Clark & Co., Chicago, Ills..... 869
Maryland Meter and Manufacturing Co., Baltimore, Md.. 886
William M. Crane & Co., New York City..... 869
Keystone Meter Co., Royersford, Pa..... 886
A. Weiskittel & Son, Baltimore, Md..... 584
The Wolff Gas Radiator Mfg. Co., New York City..... 867
Wilder Mfg. Co., Phila., Pa..... 865

**CHINA GAS KILNS.**

William M. Crane & Co., New York City..... 869

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Alvord & Co., Detroit, Mich..... 744

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New York Marine Paint Co., Poughkeepsie, N.Y..... 874

**RED CEDAR TANKS.**

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**Harris & Griffin Station Meter.**

From the fact that we have to buy a much larger meter, we now offer for sale, at a bargain, a 48x48 inch Harris & Griffin Station Meter, now in use at our works.

CHAMPAIGN & URBANA GAS LT. & COKE CO.,
1,008-3 Champaign, Ills.

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**Gas and Electric Plant in Substantial, Growing Kansas Town of 5,000 People.**

No bonds nor debts outstanding. It is a money maker. Present owners wish to retire from business. Will sell whole or half interest. $10,000 will secure half interest and the superintendency, at $75 per month. Address
1068-4 RODOLPH HATFIELD, Wichita, Kas.

## DIVIDEND NOTICE.

OFFICE OF THE AMERICAN GAS COMPANY,
222 S. THIRD ST., Phila., Pa., Nov. 20, 1895.

The Board of Directors of the American Gas Company have this day declared a dividend of $3 per share on the Capital Stock of the Company, payable on and after Dec. 2, 1895.
1068-1 MORRIS W. STROUD, Treas.

## DIVIDEND NOTICE.

OFFICE OF WELSBACH COMMERCIAL COMPANY,
40 WALL ST., NEW YORK CITY, Nov. 14, 1895.

The Directors have this day declared a quarterly dividend of two (2) per cent. on the preferred stock, payable on Dec. 10, 1895, to stockholders of record at the close of business Nov. 60. Transfer books will be closed from Dec. 1 to 10, both inclusive. Checks will be mailed.
1068-3 EDWARD C. LEE, Treasurer.

## POSITION WANTED

**As Supt. or Manager of a Gas Works or Gas and Electric Light Works.**

Fifteen years' experience as Manager of Gas Works and six years Gas and Electric Light Works. Good reasons for wishing to change present employment.
1043-tf Address "Y. B.," care this Journal.

## WANTED,

By a man who has had a round experience in the manufacture and sale of gas,

**A Position as Supt. of a Large or Small Gas Works.**

Is capable and energetic, and is willing to begin at a moderate salary. Address
1062-tf "B.," care this Journal.

## WANTED,

**A Second-Hand Gas Engine of Some Standard Make,**

that will develop from 8 to 10 horse power. Address, giving price and full particulars,

CAPITAL GAS AND ELECTRIC LT. CO.,
1065-6 Frankfort, Ky.

## FOR SALE,

**Four Purifying Boxes, 8 ft. by 8 ft.,**

with 6-inch Center Valves and Connections, in good order.

HOUSTON GAS LIGHT CO.,
1064-8 Houston, Texas.

**Utilize Your Gas Liquor.**

NO EXTRA LABOR OR OPERATING EXPENSES.

**Ammonia Concentrator,**

Not Expensive. Write to
STROH & OSIUS, Pat'ees, or
Mich. Ammonia Works, Detroit, Mich

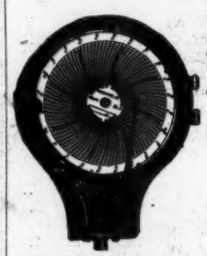
## Coal Tar For Sale.

**PROPOSALS** for the entire make of **TAR** in the works of the Pittsburgh Gas Company, for five years from the first day of January next, will be received at the Company's Office, No. 435 Sixth Avenue, Pittsburgh, Pa., until the 7th day of December, at noon. Bids to be by the net ton of 2,000 pounds of coal carbonized. Tar to be delivered in tank at our works. Right to use sufficient tar for Company's own purposes, and to reject any or all bids, reserved. Address bids to D. Herbert Hostetter, Prest.
1066-3 JOHN H. McELROY, Eng'r.

## Proposals for Coal Tar.

The North Adams (Mass.) Gas Light Company invites Proposals for its annual output of Gas Tar, amounting to 600 barrels. The gas made on these works is strictly produced from the carbonization of the best gas coal, no oil being used even for enriching purposes.
1064-tf F. S. RICHARDSON, Treasurer.

**BRISTOL'S RECORDING PRESSURE GAUGE**



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Simple in Construction,
Accurate in Operation,
Low in Price,
Fully Guaranteed.

*Send for Circulars.*

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Waterbury, Conn.

Received Medal at World's Columbian Exposition.

## FOR SALE.

Approved Very Fine Formula
(PATENT OR SECRET)
**For Manufacturing Incandescent Gas Light Mantles.**
350 per Cent. Net Profit.
Address "J. D., 491," care of RUDOLF MOSSE,
BERLIN, S.W., GERMANY.

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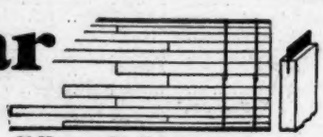

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Iron Burners of Every Description. Prices and Catalogue on Application,

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For Welsbach Lights,

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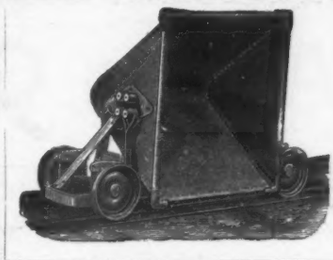

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COKE CARS for Gas Works,
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**INDUSTRIAL RAILWAYS**

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Special Trays for Iron Sponge or Oxide of Iron.

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We also make the Cheapest and Strongest

REVERSIBLE BOLTED TRAYS IN THE MARKET

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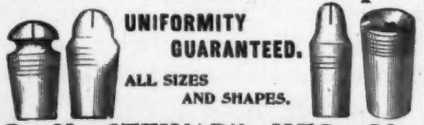

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**TRIUMPH REGENERATIVE GAS HEATER**

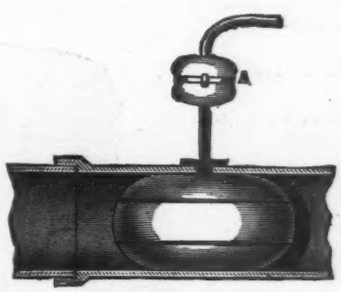
Wilder's Patents, Nov. 15 & 22, 1892.

Heats both air and gas before combustion. Gives high flame temperature and maximum economy, with entire freedom from smoke and smell. Radiates heat to the floor. Warms the feet and does not overheat the head. No headache and no colds caused by cold feet where this Heater is used. Has Group Governor, which regulates gas volumetrically proportionate to heat desired; the only correct regulation for stoves and furnaces. A gas heater, if a free gift, is still costly and extravagant if it burns gas wastefully. The Triumph Heater is constructed upon correct principles, and gives results not obtained with any other.

Write for descriptive circulars and order sample Heater.

**WILDER MFG. CO., 816-822 Cherry St., Phila.**

**Peerless Patent Improved Gas Bag**




These Gas Bags are used to stop the flow of gas while repairing or making alterations in gas mains. There have been numerous cases of workmen being badly injured, and sometimes fatally, by the escape of gas resulting from the bursting of a bag, and our patent improvement is designed to obviate such calamities. The indicator *A* shows unerringly when the bag has been sufficiently inflated to pack the main, and when the pumping should be stopped. Our Bags are made of a rubber stock especially prepared to admit of great distension, and to resist the action of Oils, Gases, Naphtha and other residuum in the mains, and they are made with lapped joints, which adds greatly to their strength.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 3-in. | Gas Bag, | each, | $0.60 | 12-in. | Gas Bag, | each, | $5.00 |
| 4 " | " | " | .80 | 16 " | " | " | 8.25 |
| 5 " | " | " | 1.05 | 20 " | " | " | 12.00 |
| 6 " | " | " | 1.75 | 24 " | " | " | 17.00 |
| 8 " | " | " | 2.65 | 30 " | " | " | 27.80 |
| 10 " | " | " | 3.75 | | | | |

**The Peerless Rubber Mfg. Co.**

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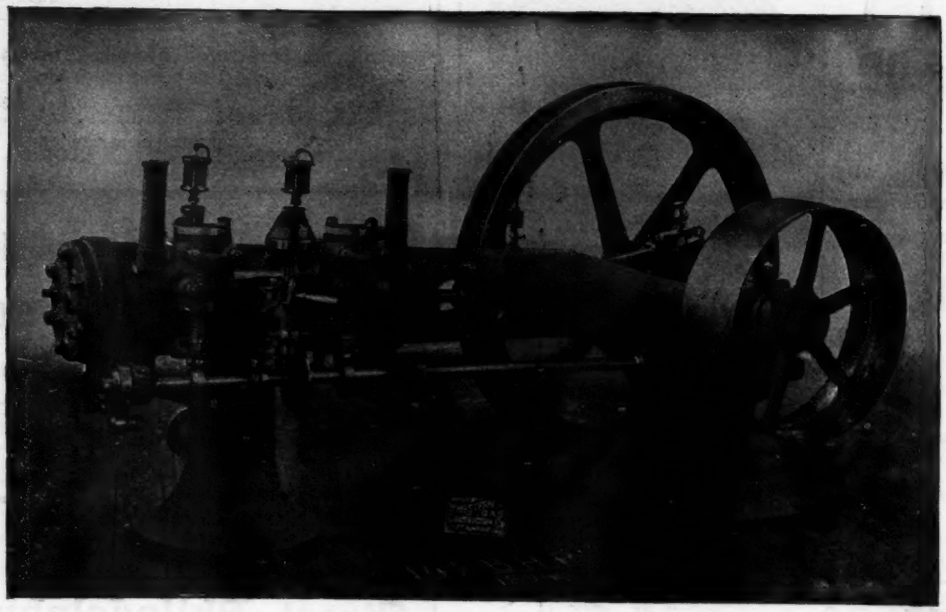
WM. W. GOODWIN, Prest. O. N. GULDLIN, V.-Prest. & Treas. H. B. GOODWIN, Sec. ERNEST F. LLOYD, Asst. Sec

# THE AMERICAN GAS ENGINE CO.,

MANUFACTURERS OF

# The Double-Acting Gas Engine,

Under the Patents of Griffin, and Dick, Kerr & Co., of London and Kilmarnock.



**Single Cylinder.**

**Impulse Every Revolution.**

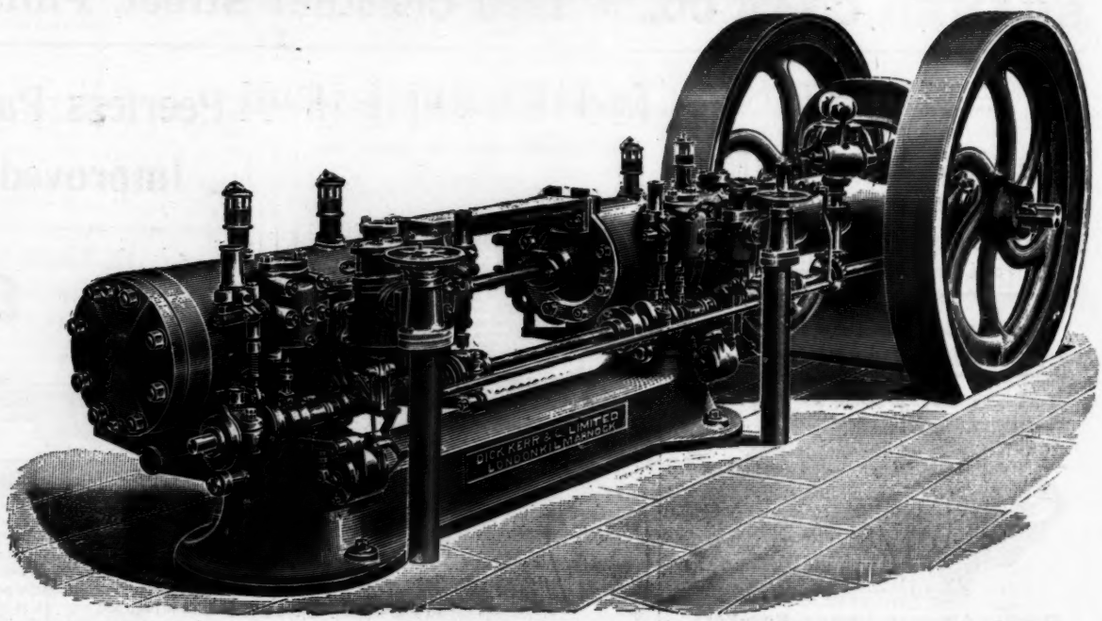
**(Two Strokes.)**

**15 to 500 Horse Power.**

For General Work and Isolated Electric Plants.

**Tandem Cylinder. Impulse Every Stroke. 100 to 1,000 Horse Power.**

For Central Stations and all work requiring extreme steadiness.




**ESSENTIAL PRINCIPLE.**—An impulse at each end of piston; using half force to each impulse; doubling the steadiness; reducing the wear on moving parts, and weight for given power. **CONSTRUCTION.**—The piston rod works through stuffing box in front end of cylinder, and connecting rod is carried in a cross-head working in a slide in frame, as in ordinary steam engine practice. All valves are of the poppet type, operated by cams on a single cam-shaft, giving positive movement to every working part. Tube or electric ignition. **RESULT.**—An engine of extreme simplicity and steadiness of action, the even wear on the cylinder and all working parts assuring increased economy, long life, and minimum cost in repairs. **RECORD.**—Successful and constant use in Great Britain for the past eight years. Address

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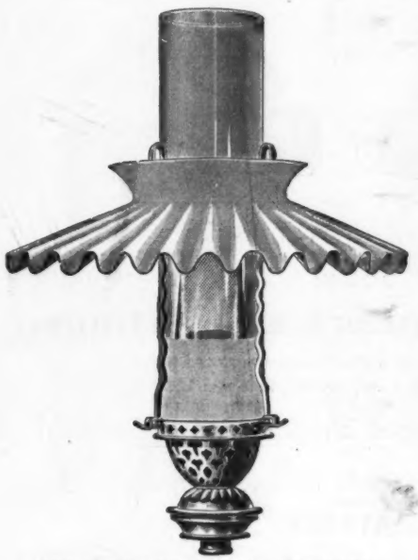
# Welsbach Light.



No. 31 Burner, with No. 74 Shade.

No. 31 Burner, with Nos. 10 and 43 Shades.

Made by the

## Welsbach Light Company,

**Gloucester City, N. J.**

**Sole Manufacturers for the United States.**

# The WOLFF Gas Radiator.

**Size, 33 Inches High, 21 Inches Wide and 10 Inches Deep.** The Trilby Heaters are furnished in Brass, Copper-Bronze and Nickel Plate.

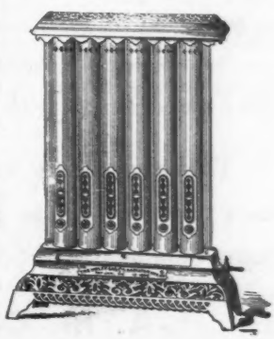
## The Most Ornamental and Economical Gas Heater in the World.

**The WOLFF Gas Radiators are no Longer an Experiment.**

Heating with gas as a fuel instead of wood or coal was made practicable only four years ago, when the first WOLFF Gas Radiator was made. Since that time we have supplied Gas Radiators to heat all kinds of Rooms, Halls, Stores, Churches, Theaters, etc.; they are used in Bed Chambers, Sick Rooms, and wherever heat is required. And, because of their great success, several imitation Gas Radiators are offered, "said to be as good as Wolff's;" but none of them are as good. The WOLFF Radiator gives more and better quality of heat, at less cost, than any gas heater in the market.

In our Trilby Heater we again offer something **new, novel** and **good,** as well as beautiful and pleasing to the eye. Most Stoves, Heaters and Radiators in use heat the **top** of the room, leaving the **floor** cold (hence keep the head warm and the feet cold). Our Trilby Heater warms the floor first; then the heat rises gradually, warming the whole room comfortably, cold air being drawn in from the bottom (passing between the heated radiating flues) and thoroughly warmed before passing out at the top, while the gas, mixed with air, is burned in our "Patent Incandescent Iron Fires Burners," which greatly intensifies the heat, causing an extra amount of heat to be radiated, or thrown off onto the floor, while the products of combustion are carried up through radiating iron flues to the top of the Trilby Heater, and downwards and out through opening to flue or chimney pipe connection, making a current or outlet for burnt gas or impure air, thus causing perfect ventilation in the room.

The Trilby uses less gas and gives more and better heat than any other Gas Radiator in the market.



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# Bray's Patent "Enamel" Gas Burners.

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Are the Cheapest, Most Economical and Most Durable in existence, and will, at their REDUCED PRICE, save their cost in gas alone in forty hours' use.

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**Made with Inside Screw, to Suit American Fittings.**

The "Specials" are made to suit Low and High Pressures. The "Adjustables" consist of two Burners screwed together, the sizes of which can be arranged to suit any Pressure and Consumption. For full description see Catalogue.

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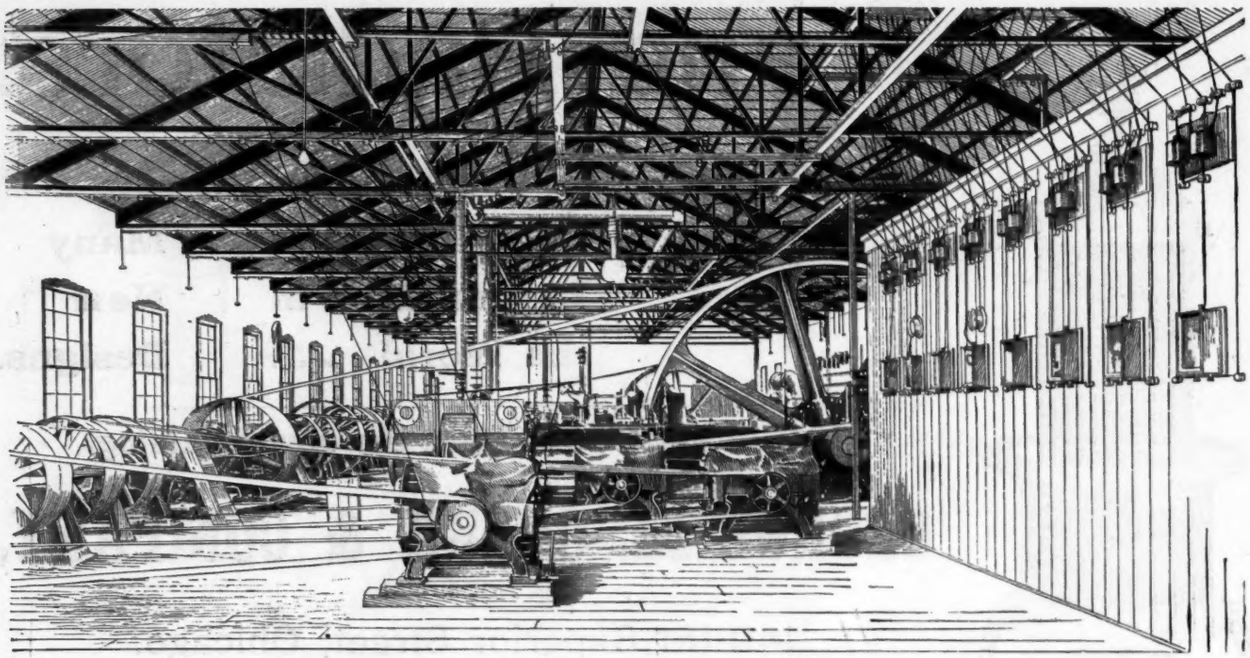

The above illustration is taken direct from a photograph, and shows the construction of an Iron Truss Roof designed and built by us for the Connecticut Electric Company, at Waterbury, Conn. The building is 51 feet in width by 251 feet in length, with brick walls and iron truss roof covered with corrugated iron. For an Electric Light Station, where the risk from fire is very great, this construction particularly commends itself, as this risk is entirely eliminated.

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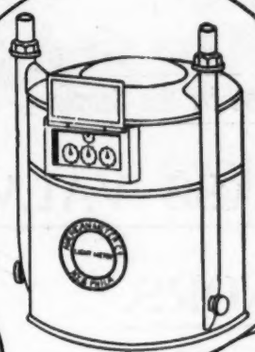

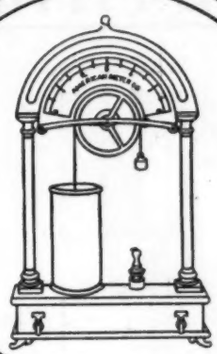

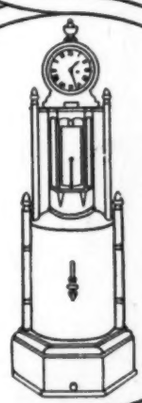

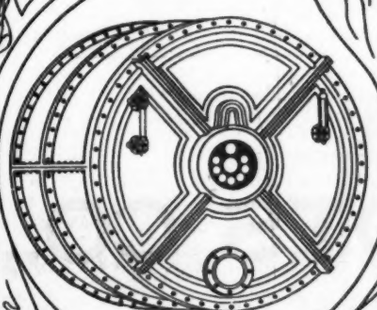

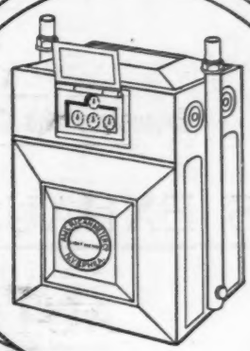

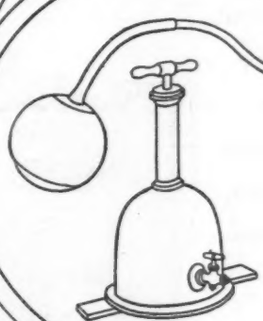

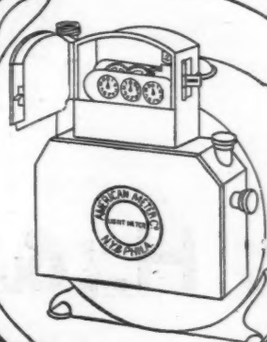

## PUBLIC LIGHTING TABLE.

### DECEMBER, 1895.

| Day of Week. | Date. | Table No. 1. Following the Moon. Light. | Table No. 1. Following the Moon. Extinguish. | Table No. 2. New York City. All Night Lighting. Light. | Table No. 2. New York City. All Night Lighting. Extinguish. |
|---|---|---|---|---|---|
| | | | | P.M. | A.M. |
| Sun. | 1 | No L. FM | No L. | 4.20 | 6.10 |
| Mon. | 2 | No L. | No L. | 4.20 | 6.10 |
| Tue. | 3 | 5.00 PM | 6.30 PM | 4.20 | 6.15 |
| Wed. | 4 | 5.00 | 7.40 | 4.20 | 6.15 |
| Thu. | 5 | 5.00 | 8.50 | 4.20 | 6.15 |
| Fri. | 6 | 5.00 | 10.10 | 4.20 | 6.15 |
| Sat. | 7 | 5.00 | 11.20 | 4.20 | 6.15 |
| Sun. | 8 | 5.00 LQ | 12.40 AM | 4.20 | 6.15 |
| Mon. | 9 | 5.00 | 1.50 | 4.20 | 6.15 |
| Tue. | 10 | 5.00 | 3.00 | 4.20 | 6.20 |
| Wed. | 11 | 5.00 | 4.10 | 4.20 | 6.20 |
| Thu. | 12 | 5.00 | 6.10 | 4.20 | 6.20 |
| Fri. | 13 | 5.00 | 6.10 | 4.20 | 6.20 |
| Sat. | 14 | 5.00 | 6.10 | 4.20 | 6.20 |
| Sun. | 15 | 5.10 NM | 6.20 | 4.20 | 6.20 |
| Mon. | 16 | 5.10 | 6.20 | 4.20 | 6.20 |
| Tue. | 17 | 5.10 | 6.20 | 4.20 | 6.20 |
| Wed. | 18 | 5.10 | 6.20 | 4.20 | 6.20 |
| Thu. | 19 | 5.10 | 6.20 | 4.20 | 6.20 |
| Fri. | 20 | 8.00 | 6.20 | 4.20 | 6.20 |
| Sat. | 21 | 9.00 | 6.20 | 4.20 | 6.20 |
| Sun. | 22 | 10.00 | 6.20 | 4.20 | 6.20 |
| Mon. | 23 | 11.00 FQ | 6.20 | 4.20 | 6.20 |
| Tue. | 24 | 12.00 AM | 6.20 | 4.20 | 6.25 |
| Wed. | 25 | 1.00 | 6.20 | 4.20 | 6.25 |
| Thu. | 26 | 2.10 | 6.20 | 4.20 | 6.25 |
| Fri. | 27 | 3.20 | 6.20 | 4.20 | 6.25 |
| Sat. | 28 | 4.20 | 6.20 | 4.20 | 6.25 |
| Sun. | 29 | 5.30 | 6.20 | 4.20 | 6.25 |
| Mon. | 30 | No L. | No L. | 4.20 | 6.25 |
| Tue. | 31 | No L. FM | No L. | 4.20 | 6.25 |

### TOTAL HOURS LIGHTING DURING 1895.

| By Table No. 1. | Hrs. Min. | By Table No. 2. | Hrs. Min. |
|---|---|---|---|
| January | 237.00 | January | 423.20 |
| February | 196.40 | February | 355.25 |
| March | 195.50 | March | 355.35 |
| April | 165.30 | April | 298.50 |
| May | 153.40 | May | 264.50 |
| June | 138.20 | June | 234.25 |
| July | 146 30 | July | 243.45 |
| August | 152.50 | August | 280.25 |
| September | 165.10 | September | 321.15 |
| October | 186.10 | October | 374.30 |
| November | 204.10 | November | 401.40 |
| December | 219.30 | December | 433.45 |
| Total, yr. | 2161.20 | Total, yr. | 3987.45 |

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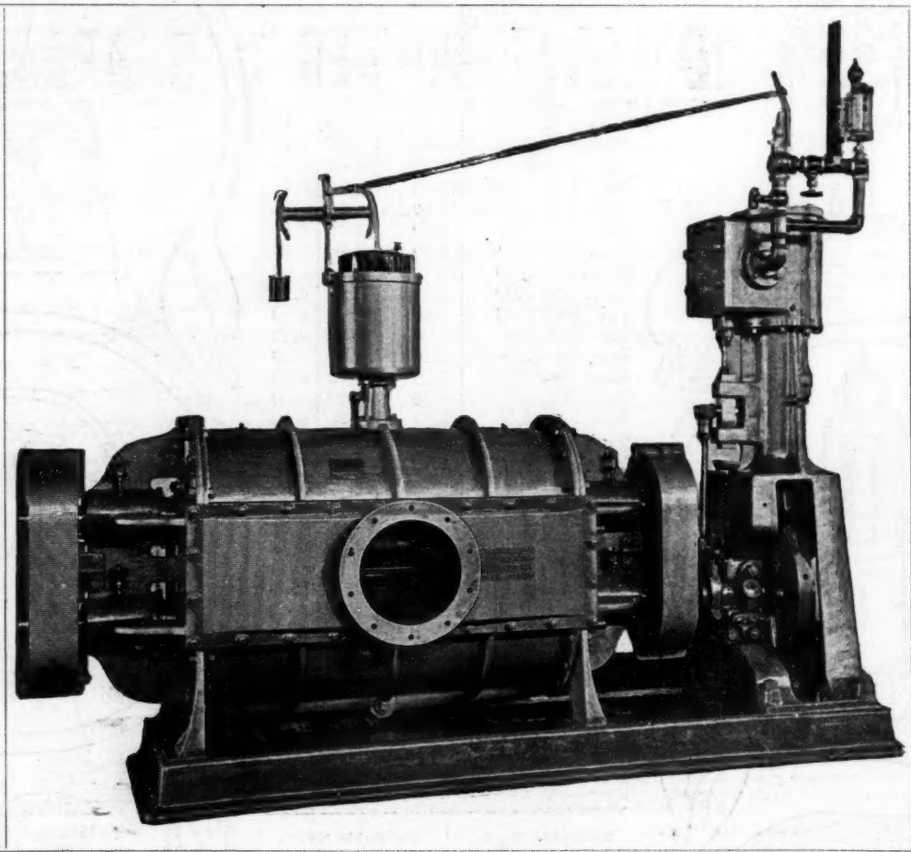

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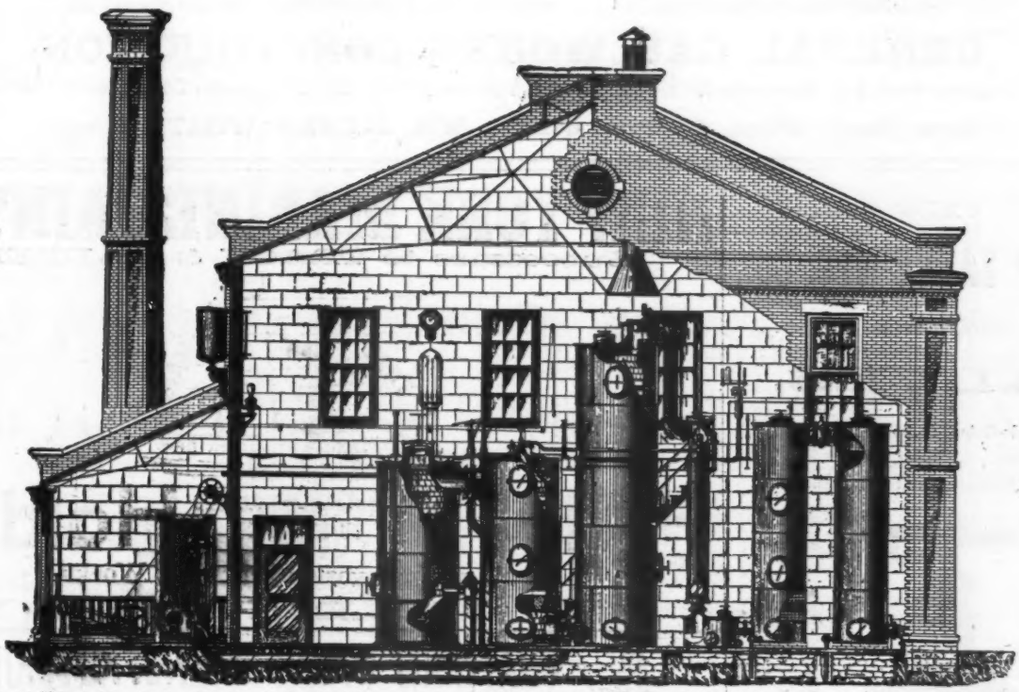

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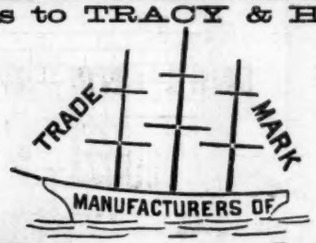


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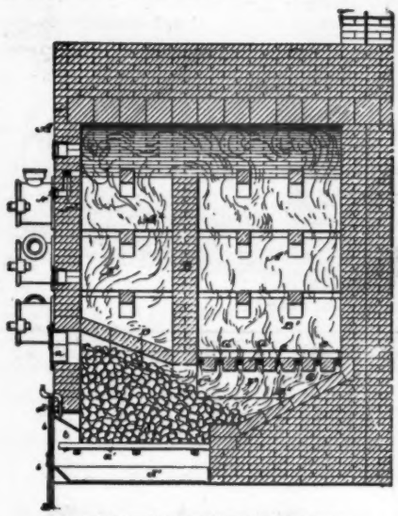

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## For the Year 1894.

An Analysis of the Accounts of the Principal Gas Undertakings in England, Scotland, and Ireland. Being the Twenty-fourth Year of Publication. Compiled and Arranged by

**JOHN W. FIELD Accountant to the Gas Lt. and Coke Co., London.**

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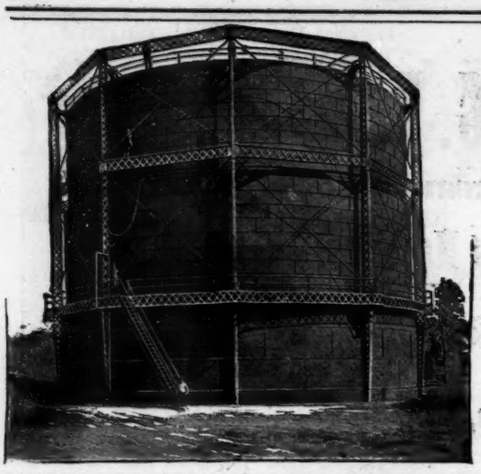

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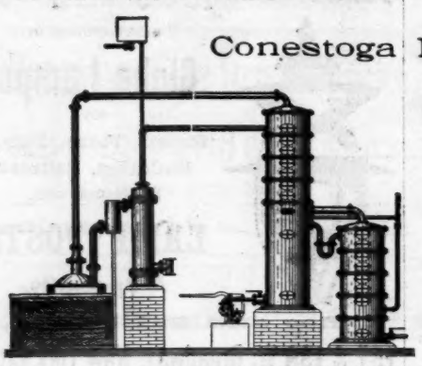

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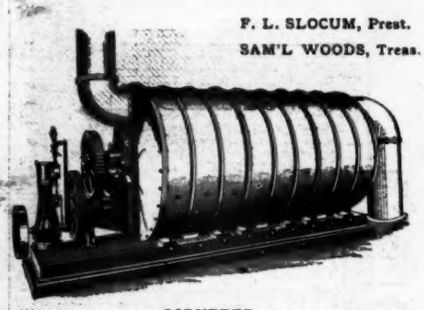

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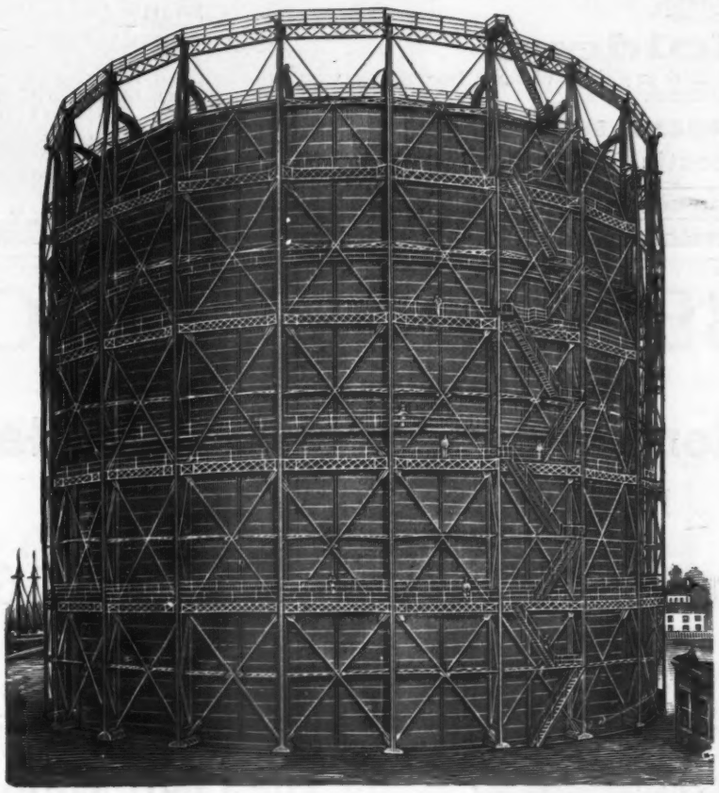

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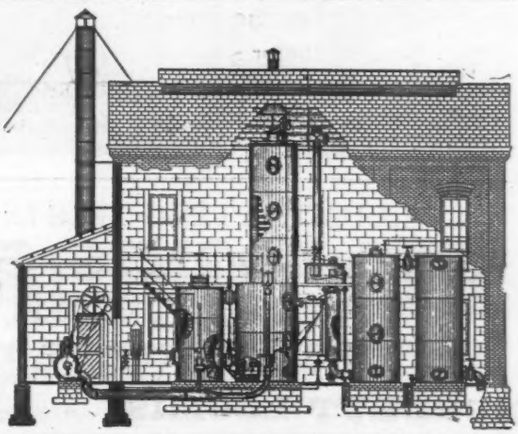

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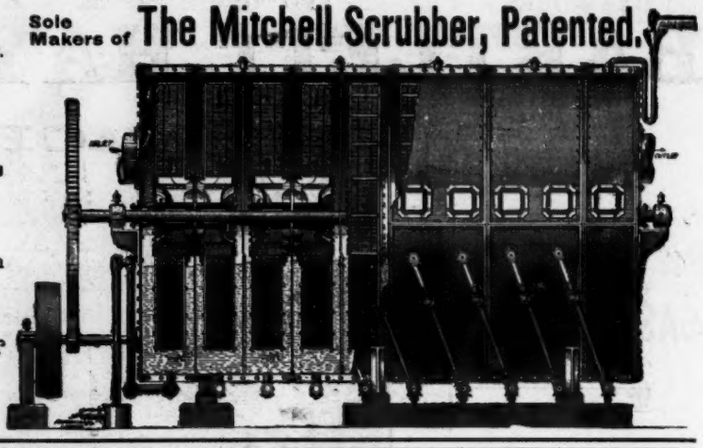

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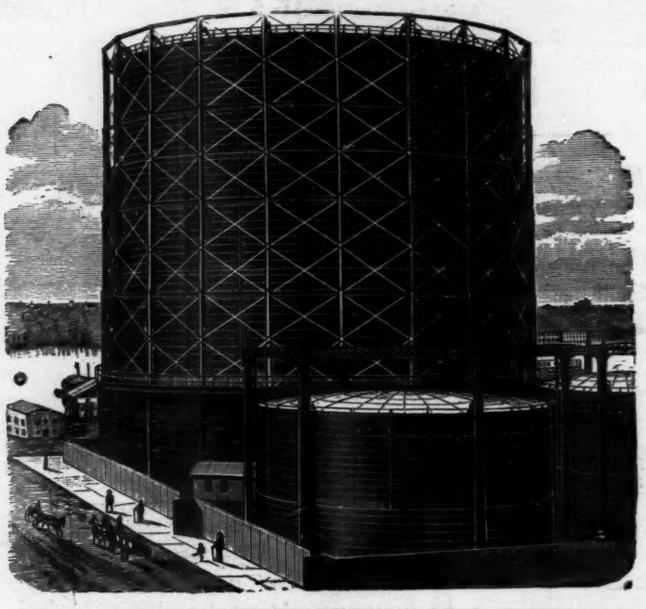

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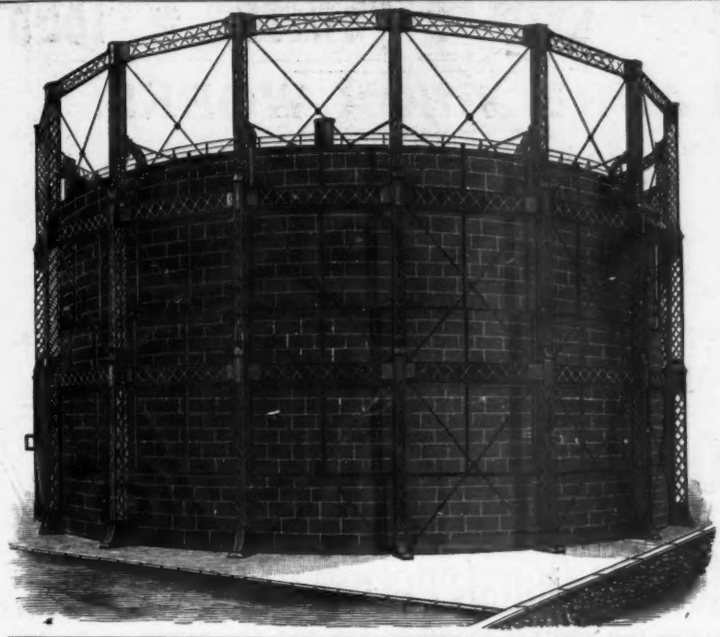

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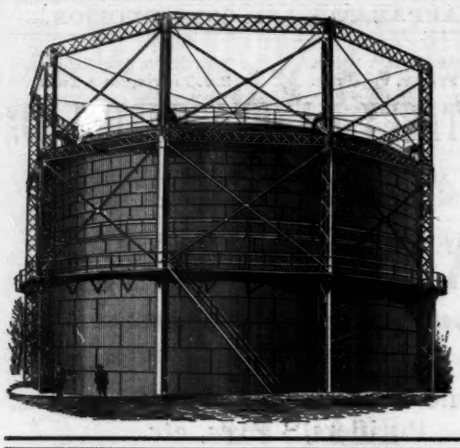

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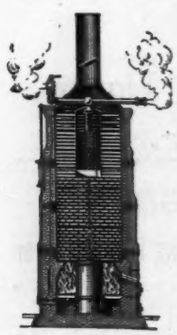

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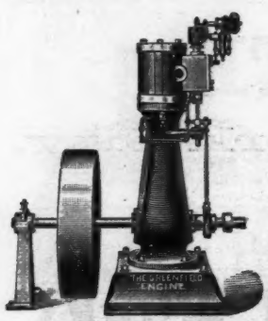

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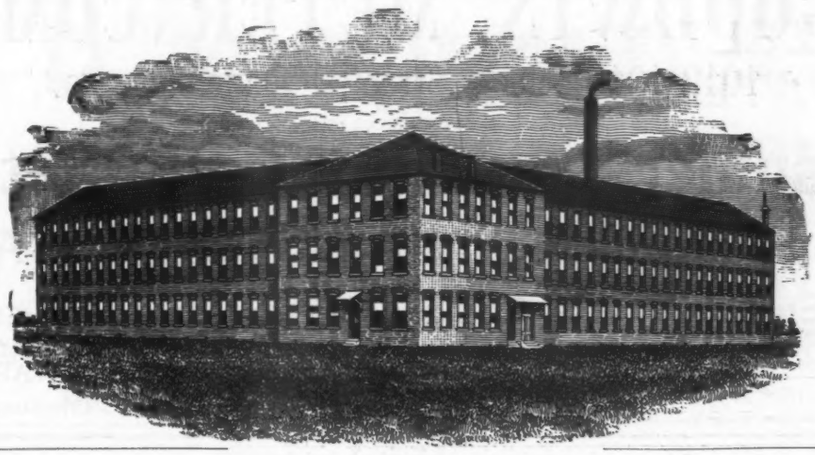

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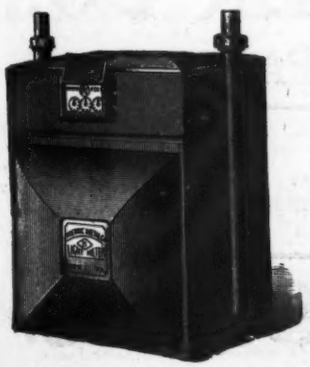

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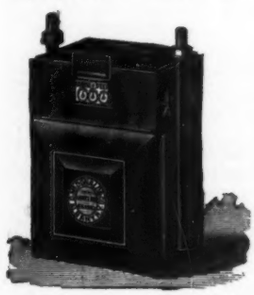

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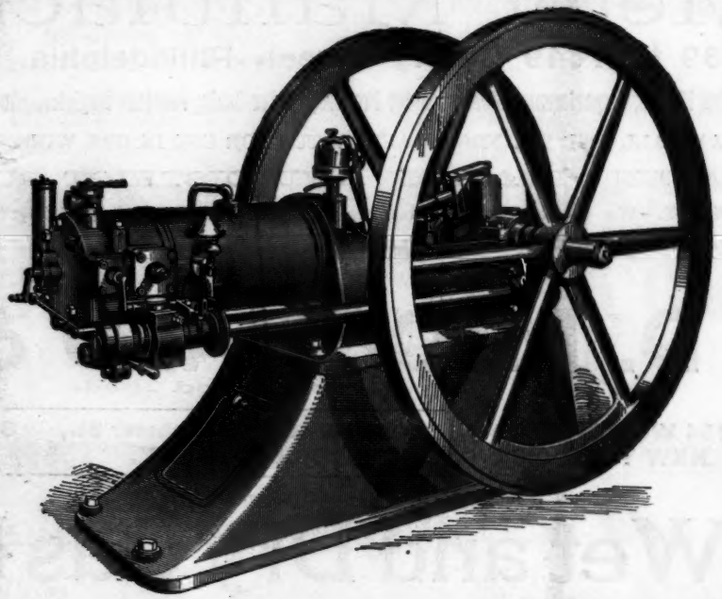

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It is almost a quarter of a century since the "Otto" revolutionized old and bad practices by introducing principles of combustion "entirely new" in the construction of Gas Motors.

**A quarter of a century** of uninterrupted success has demonstrated the correctness of these principles.

The gas engine history of the past proves that all competitors have recognized this fact by becoming imitators.

Since its advent the "Otto" engine has been illustrating mechanical improvement without alteration, while others have been offering alterations as improvements.

**The experience** of the past shows that it requires years to determine the real merits of a gas engine, and that nearly all new gas engines prove failures. **The fittest survive, and the only safe thing to do** in selecting a gas engine is to buy what the tests of practical use, through a long period of time, have proven to be the best.

**The Practical Tests of a Quarter of a Century have Demonstrated that the "OTTO" Stands To-day Unrivaled**

For simplicity of construction and grace in design; for general reliability and ease of management; for quiet and smooth running qualities; for efficiency and low gas consumption; for regularity of speed and close regulation of power.

**"OTTO GAS ENGINE WORKS," Inc., 33d & Walnut Streets, Phila., Pa.**

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